SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER 1908.

GENERAL PHYSICS.

1358. *Integrator.* **Jacob.** (Comptes Rendus, 147. pp. 83–84, July 6, 1908.)—The author's apparatus shown to the Academy on May 11, 1908, allows the equation $y' = Ay^3 + By^2 + Cy + D$ to be integrated when one particular solution is known. The same apparatus, slightly modified, dispenses with this restriction. In the earlier apparatus a groove, which was an essential part of the apparatus, regulated the movement of a plate. In the new form, this groove is placed on a carrier which can move at right angles to the groove. The motion is determined by causing the tracing-point to move along a curve called the *directrix,* whose co-ordinates are calculated by the help of the coefficients of the equation. The readings are taken exactly as with the earlier apparatus. Thus the general equation $y' = Ay^3 + By^2 + Cy + D$ can be integrated whatever the functions A, B, C, D may be. A. W.

1359. *Electrical Anemometer.* **R. B. Goldschmidt.** (Elektrotechn. Anzeiger, 25. p. 526, June 14, 1908. Elect. Engin. 41. p. 874, June 19, 1908. Abstract.)—The apparatus records the velocity of the wind (or of currents of gases) as well as its direction with the aid of two independent galvanometers. Two exactly similar Pt-wires are so mounted that the one is directly exposed to the wind, and the other protected by a tube and a conical cap; the exposed wire will be cooled by the air in motion. The two wires and the recording galvanometer are differentially coupled in a Wheatstone bridge. The galvanometer is calibrated by swinging the wire round at known rates; this is simpler than producing air currents of certain velocities, but it presumes the air to remain still and at constant temperature while the wire is cutting through it. In order to obtain a record of the wind direction, a pointer is made to move with the vane; the pointer dips into an annular mercury trough in circuit with a rheostat. Applications are not mentioned. H. B.

1360. *Autographic Recorder for Testing.* **H. F. Moore.** (Eng. Record, 58. p. 12, July 4, 1908. Paper read before the Amer. Soc. for Testing Materials, June, 1908.)—An ordinary steam-engine indicator is fixed to the frame of the testing machine. A cord attached to one of the straining heads passes over a pulley on the other and round the pulley of the indicator drum. The spring of the indicator is placed directly over the rear end of the beam, to which it is attached by a stiff rod. In a test, the jockey weight is run out until the rising of the rear end of beam has compressed the spring almost fully. Upon applying load in the usual way, but keeping the jockey weight in the same position throughout, the movement of the indicator pencil is proportional to the load (the principle being practically that of the most recent Buckton recorder). It is stated that tests can be made at the rate of one every four minutes, with consistent indication of yield-point. The addition of a device for using a continuous roll of paper would decrease this time still further. F. R.

1361. *Surface-tension of Large Drops.* **Gouy.** (Comptes Rendus, 146. pp. 1874–1876, June 29, 1908.)—The author uses a formula by Mathieu in his "Theory of Capillarity." The drop of mercury must be rigorously circular, as seen in plan; it rests in a hemispherical cup of glass whose radius is 4 cm. This drop is covered by some electrolyte and is polarised to its maximum of surface tension, and its dimensions are taken when in this condition. The electrolytes include sulphuric acid, sodium sulphate, potassium bromide, and potassium iodide. The consistency of constants obtained when different electrolytes are used indicates the accuracy of the method. The mean value of surface tension mercury-water works out at 426·7 c.g.s. These values refer to a surface prepared recently. After a time, depending on the electrolyte, the surface tension diminishes rapidly. This effect is not explained. P. E. S.

1362. *Resistance of Wire to repeated Bending.* **A. Schuchart, Senr.** (Stahl u. Eisen, 28. pp. 945–949, July 1, and pp. 988–993, July 8, 1908.)—In the author's experiments the steel wire under test was gripped in jaws with curved edges of radius R, and bent over into actual contact, in each direction alternately. The number (N) of bendings required to break the wire, when plotted as a function of R, lie on a parabola. In practice the vertex of the parabola so nearly coincides with the origin that the rule approximately followed is: N varies as R^2. N is the same for different wires with equal bending strength when the ratio $(2R + \delta)/\delta$ is the same. δ is the diam. of the wire. N varies inversely as δ, for a constant (large) value of R. F. R.

1363. *Hardness Testing and Hardness.* **E. Meyer.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 645–654, April 25; 740–748, May 9, and pp. 835–844, May 28, 1908.)—For 28 different metals and alloys the author found that the relation between the load P in kg. and diam. of impression d in mm., in the Brinell test with a ball of 10 mm. diam., was without exception of the form $P = ad^n$, where a has values from 20 to 270, and n from 1·91 to 2·38, a and n being constants for the same metal. The metals in the series included lead, aluminium, and some alloys, copper and alloys, cast irons, steels, and a series of nickel steels containing from 0 to 16 per cent. Ni. The coefficients vary for the same material with different values of ball diam. D according to the relation $a \propto D^{2-n}$. The hardness number taken as $P_m = P/(\pi/4)d^2 = (4a/\pi)d^{n-2}$; and for materials in which $n = 2$, P_m is independent of load, angle of impression, and diam. of ball. The values of P_m are compared with the Brinell hardness-numbers (P ÷ spherical area of depression) for various loads. At considerable loads the proportional difference between the two figures is very considerable for the softer materials. But as, except for copper, neither figure is nearly constant for various loads, it appears simpler to adopt P_m as the hardness number. A comparison of Föppl's hardness test (in which a cylindrical bar is pressed into another arranged at right angles to it, and the hardness number is the load ÷ area of impression) with the Brinell number for the same materials gave the following results: For copper, mild steel, grey cast-iron, white cast-iron, the cylinder hardness-numbers had the ratios 0·75 : 1·35 : 1 : 1·42, and the ball hardness-numbers the ratios 0·55 : 0·99 : 1 : 1·48 respectively, for an impression 1 mm. diam. and with a different unit in the two series. The unit with ball test bears to that in the cylinder test in these series the ratio 1 : 0·46. In comparison with the conical punch hardness test [see Abstract No. 196 (1908)] it is found that the punch-test hardness-numbers are higher than the ball-test numbers, especially for ball numbers obtained with impressions of 1 mm. diam. Tests by Martens' scratch hardness method, in which a conical diamond point makes a scratch on the polished sample under known pressure, show that the ratio of the scratch-hardness number to the Brinell hardness-number tends, with a few exceptions, to become greater, the harder the sample. A general discussion of hardness and its measurement leads to the need of knowing the effect of permanent deformation upon the hardness of a metal. A tensile test-bar of mild steel showed a max. Brinell number of 205 near the fracture; in the portion which only underwent general elongation the hardness was about 160; the hardness before testing in tension was about 130. Generally the hardness increases with the contraction of area. A limited series of experiments indicated that n (in the equation $P = ad^n$) is constant for varying amounts of permanent deformation in tension, whilst a is variable, for any particular specimen. F. R.

1364. *Effect of the Interval before Tamping Wetted Concrete.* **H. Burchartz.** (Königl. Materialprüfungsamt, Mitt. 26. 4. pp. 192–200, 1908.) — Experimental results obtained with twelve German standard cement-mortars are given. At different periods after the addition of the water, the mortars were thoroughly worked and tamped into the moulds. Tensile and compression tests made at various periods after tamping show the very deleterious effect of disturbing the cement to become marked 8 hours or less after wetting. Although the cement continues to gain strength, as usual, in course of time, yet its tensile strength remains diminished by the disturbing in a constant proportion. The figures vary greatly for the different cements, which had very different times of setting. These properties and the sp. gr., loss on ignition, and fineness of grinding are given in detail. F. R.

1365. *Bond in Reinforced Concrete.* **M. O. Whitey.** (Eng. Record, 57. pp. 798–800, June 27, 1908. Paper read before the Amer. Soc. for Testing Materials.)—Exception is taken to results of bond experiments made by pulling a rod from a cylinder of concrete in which it is embedded, on the ground that the high compressive stress on the end of the cylinder where the rod comes through affects the true bond. Tests were made upon reinforced beams, in which the central portion of the plain round mild steel reinforcing bars was left uncovered with concrete. The max. bond strength thus obtained in 1 : 2 : 4 concrete was from 200 to 250 lbs. per sq. in. The bond increased with age of concrete up to six months, and had reached 80 per cent of the max. value in 1 month. Comparative tests, made by pulling a rod directly from a block, gave values of the bond from 40 to 200 per cent. higher than those given by the beams. The amount of water used in mixing had no decided effect on bond of 1 : 2 : 4 concrete two months old. The average bond was about the same for 1 : 2 : 4 (limestone), 1 : 2 : 4 (gravel), and 2 : 5 mortar, but was decidedly lower for 1 : 3 : 6 (limestone). F. R.

1366. *Pressure-loss in Flow of Liquids and Gases.* **R. Biel.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1035–1038, June 27, and pp. 1065–1071, July 4, 1908.)—A brief discussion is first given of the ordinary Poiseuille formula which takes no account of the roughness of the tubes through which the liquid in question is flowing. The author then proceeds to describe researches on the flow of various liquids (water, ether, rape-seed oil, mercury, liquid CO_2) and gases (air, steam, hydrogen, coal-gas), and deduces formulæ in which the roughness of the tube as well as the viscosity of the fluid is taken into account. The results of the experiments are given in numerous tables and diagrams. Instead of the Poiseuille formula $h = 32lv\eta/gd^2\gamma$, where l is the length of the tube, v the velocity of the fluid, η the viscosity coefficient, d the diam. of the tube, and γ the density of the liquid, the author finds that the pressure-loss is given by $h = (4lv^2/d)\,(a_1 + b_1/v)$; b_1 is proportional to the viscosity coefficient, but a_1 is independent of it. Both a_1 and b_1 depend on the diam. and the roughness of the tube ; $a_1 = a + 2f/\sqrt{d}$, where a is a constant and f is proportional to the roughness of the tube, being zero for perfectly smooth walls. $b_1 = 2b\eta/\gamma\sqrt{d}$, where b decreases with increasing roughness of the tube. Values of $a, f,$ and b are given for water, air, and steam. Hence the final form of the equation for the pressure-loss is $h = (4lv^2/d)[a + 2f/\sqrt{d} + 2b\eta/v\gamma\sqrt{d}]$. Bazin has recently obtained a formula similar to the above, the first two terms of the expression in brackets being almost identical as regards numerical values. [See also Abstract No. 212B (1908).] A. W.

1367. *Influence of Large Towns on Atmospheric Humidity.* **V. Kremser.** (Meteorolog. Zeitschr. 25. pp. 206–215, May, 1908.)—The relatively high temperatures of large towns might be expected to lead to an increase of the vapour pressure of town atmospheres ; observations show, however, a relative decrease. The author examines the data for Paris (Jaubert), Vienna (Hann), Berlin (two series, by J. Schubert and himself), Trier, Cologne, and Breslau. His observations concern a street in the town and the country station at Blankenburg, 10 km. N. of Berlin, and the period 1891 to 1900. It results that the town air is almost throughout the year, particularly during the summer, relatively and absolutely drier than the country air. In Northern Germany the mean vapour pressure for the year is by 0·4 mm., and the mean for June by 0·9 mm. greater in the country than in the towns ; these numbers represent differences in the relative humidity of 6 and 9 per cent. These differences do not appear to be great ; but the standard mean vapour pressure does not, in Northern Germany, vary by more than 0·9 mm. for the year, by more than 1·1 mm. for July, and by more than 1·7 mm. for Dec., and the relative humidity is affected by town and country to nearly the same extent as by the usual summer fluctuations. Large towns, therefore, cause considerable disturbances in the local distribution of the humidity ; the deficiency of absolute and relative humidity in towns follows pretty closely the annual temperature curve, and in the course of the day the deficiency in the vapour pressure also follows the temperature curve ; the diminution in the relative humidity is most marked in the evening hours. The diminution of humidity might be due to the many fires of large cities and to the condensation of vapour by dust, smoke, sulphurous vapours, &c.; but the relative dryness of the town atmosphere is more striking in summer than in winter. More probably the general draining of the town ground is the primary cause; the warmer soil favours vertical air currents; in the narrow, dark streets, however, evaporation and vertical currents are checked by wet winters. Exceptional conditions may, of course, reverse the relations. Attention is drawn to the hot summer and July of 1904, during which country and town humidity were practically equal, instead of differing more strongly; that case was not exceptional, however, because the long drought had thoroughly dried the whole soil. H. B.

1368. *Effect of Cross Wind on Projectiles.* **A. Mallock.** (Roy. Soc., Proc. Ser. A. 80. pp. 595–597, June 20, 1908.)—If the air-resistance acts always in the direction of the resultant of the velocities of wind and projectile, the angle between resultant velocity and line of aim is constant throughout the range, and independent of the law connecting velocity and retardation. In order, however, that the resistance may act in the direction of the resultant velocity, the axis of symmetry of the projectile must take that direction. Assuming this, Younghusband's result, $\eta = w\,(t - R/v_0)$, is readily adduced. Here η is the vertical co-ordinate of the position of the shot, v_0 the initial velocity, w the velocity of the wind, and R the range at the time t. Initially, however, the axis makes an angle w/v_0 with the resultant velocity, and the resistance has therefore a horizontal component at right angles to the resultant. Thus the question as to how far the above equation can be expected to give a true value for the effect of wind depends on the rate at which the projectile can set its axis in the direction of the wind, which, arguing from the results given in a former paper [see Abstract No. 1611 (1907)], will vary directly as the linear dimension (L) of the projectile. Hence, instead of the above, we should write $\eta = AL + w(t - R/v_0)$, where A is a constant depending on the form, weight, and initial velocity of the projectile. If experiments were made on wind deflection, the velocity of the wind being recorded at positions along the range at the instant of firing, A might be determined, and hence the angle which the axis of a projectile fired in still air makes with the tangent to the trajectory. Attempts to measure this angle photographically have hitherto proved unsuccessful.

F. R.

1369. *Meteorological Balloons and the Temperature of the Upper Air.* **A. Mallock.** (Roy. Soc., Proc. Ser. A. 80. pp. 580–584, June 10, 1908.)—As the exploration of the atmosphere by rubber balloons indicates that an almost constant temperature is reached when the pressure has decreased to about 150 mm., the author examines theoretically to what heights such balloons might ascend. The determining factors are the relative densities of the balloon gas and of the air outside at the same pressure, the ratio of the dead weight of the balloon and fittings to the total lifting force at ground-level, and the compression by the elasticity of the balloon of the gas it contains. It results that the velocity of the balloon will first increase as the one-sixth power of the ratio of density of the air at the elevation attained to the density at the ground-level; when the elastic compression is small, the upward velocity will reach its max. not far from the greatest possible elevation. The author further compares the actual temperatures with the adiabatic temperatures, and finds that the observed decrement is, down to a pressure of rather less than 200 mm. (corresponding to a height of 11 km.), almost exactly 0·7 of the adiabatic decrement. At this pressure the temperature remains between −50° and −60° C. up to the greatest height reached, approaching 20 km. Greater heights might be attained by the aid of more expansible balloons, larger in volume, and made of thinner material. H. B.

1370. *Temperature Gradients over Munich, Jan. 2 to 4, 1908.* **A. Schmauss.** (Meteorolog. Zeitschr. 25. pp. 263–267, June, 1908. Königl. Bayer. Meteorolog. Zentralstation, München, April, 1908.)—The three balloons sent up with registering instruments on these three days (international days) were all recovered in the best order; the days were the coldest of the year, and coincided with a barometric maximum. The records obtained are here analysed up to 3,000 m., and the thermo-isoplethic curves reproduced for intervals of 100 m., starting with the 520-m. level (the level of Munich). On Jan. 2 the surface temperature was −6·8° C.; at 1,200 m. it was −10°, at 1,400 m. −10·6°; the temperature then rose to −9° at 2,400 m., and fell again to −11·6° at 3,000 m. On Jan. 3 the surface temperature was −15·9°; the minimum of −17° was observed at 800 m.; the temperature then rose to −5° at 1,700 m., and fell again to −11·7° at 3,000 m. On Jan. 4 the minimum of −19·2 was on the surface; the temperature rose to −0·5° at 1,800 m., and fell again slowly and steadily to −8·8° at 3,000 m. Thus the greatest negative changes occurred near the surface; the inversion commenced in the higher strata and advanced downward; the stratum of lowest temperature also advanced downward, and fell finally on the surface. The thermo-isoplethic curves all tended to become parallel to the surface. The downward movement of the stratum of inversion had been noticed by Erk in 1891. The author further shows that the high-level stations were on these days all colder (by as much as 6° C. in some instances) than the free atmosphere. Only the lower strata seem to be affected by the abnormal cold of winterly barometric maxima; the temperatures of the higher strata approach the yearly means. H. B.

1371. *Vertical Temperature Gradient in the Swiss Alps.* **J. Maurer.** (Meteorolog. Zeitschr. 25. pp. 241–246, June, 1908.)—The author does for the Swiss Alps and the period 1864 to 1900 what J. Hann had done for the Austrian Alps and the period 1851 to 1880, and he reduces his data, like Hann, by the method of mean squares. His standard level is 500 m.; his highest station has an altitude of 2,475 m. For the purpose of the analysis he divides Switzerland into four districts: the Jura; the northern slope, with a subdivision of the Rhine Valley and the Grisons (Swiss Eastern Alps); the southern slope; Wallis (Le Valais); the hill districts (up to 1,170 m.) of the N.E. of Switzerland make another subdivision. The means and the fall of temperature per 100 m. are deduced for each month. The final mean gradients are 0·510° C./100 m. for the northern slope, 0·588° for the southern slope, 0·514° for the eastern Swiss Alps, while Hann found 0·507° for the northern and 0·600° for the southern slope of the Austrian Alps. The agreement is therefore satisfactory, and there is no particular reason to separate the eastern Swiss Alps. The gradients of Hirsch and Weilenmann of 1809 and 1871 were greater. When we assume a uniform vertical gradient, the temperature is too warm for the strata lying between 900 and 1,800 m., and in spring and summer even up to 1,700 m; this is particularly noticeable on the southern slope of the Alps. There are also a number of spots (8 mentioned) which are exceptionally cold all through the year, especially in winter, and others (11 mentioned) which are exceptionally warm; some of the latter are Foehn stations. H. B.

1372. *Variations of the Duration of Twilight.* **E. Esclangon.** (Comptes Rendus, 147. pp. 27–29, July 6, 1908.)—On July 1, 1908, at Bordeaux the twilight was so prolonged as to attract the particular notice of the inhabitants of the surrounding country. The sky appeared normally clear. At the Observatory at Floirac a watch could easily be read up till 9h. 56m. p.m. On the following night it could only be read up till 9h. 15m. p.m.; thus there was a difference of 40 min. on two consecutive evenings. This mode of testing the illumination was adopted in preference to noting the times of appearance of stars of different magnitudes, because the latter method brings in the question of the transparency of the air. On July 1, after sunset, a rosy glow lit up the sky 45° above the sun for a brief interval. It was not seen on July 2. Crepuscular glows of this kind are often seen at Bordeaux. Before and after their apparition the sky appears perfectly clear. According to the author [Abstracts Nos. 617 (1903) and 718 (1904)], the rosy light is due to the presence, in elevated regions of the atmosphere, of very tenuous clouds, which are invisible except for a short time (10 min.) during twilight, when the decreasing illumination of the sky has reached a certain stage. These invisible clouds appear also to be the cause of the abnormal prolongation of twilight. They would also cause an increase of the coefficient of absorption, and thus the visibility of celestial bodies would be diminished for a double reason. Hence an abnormal increase in the length of twilight, with a cloudless sky, is an index of a sky not very favourable for astronomical observations. A. E.

1373. *A Cylindrical Cloud.* **Van de Vyver.** (Annal. Soc. Sci. de Bruxelles, 32. 2. pp. 132–139, 1907–1908.)—In the forenoon of Nov. 28, 1907, at 22h. 55m. (G.M.T.), the author observed at Ghent a cylindrical cloud, resembling an immense smoke column issuing from a chimney, slowly advancing from S.W. to N.E. At first the cylinder was quite perfect; at an altitude of 6° it had a diam. of 14°, and its length was 140°; the upper portion appeared white on a grey sky, the lower portion was bluish black. By 23h. 10m. the dissolution of the cloud had become marked, and soon afterwards rain began to fall, while the S.S.W. wind suddenly changed to E. The author discusses the meteorological features of the day, and regards the cloud as an aerial wave. Balloon observations show that the wind frequently blows from the N.W. at a certain height near Ghent, no matter what the surface wind be; this current seems to be a sea-wind that curves upward inland. The cloud moved parallel to the coast-line. H. B.

1374. *Cirrus Observations in Batavia.* **W. van Bemmelen.** (Meteorolog. Zeitschr. 25. pp. 226–228, May, 1908.)—Observations are made with a cloud theodolite crossed by six wires so that 12 sectors of 30° are formed. P. J. Smits observed in 1907 254 cases of real cirrus and made the calculations. According to van der Stok and Figee the altitudes are: real cirrus, 11 to 12 km.; cirro-stratus, 10 to 11 km.; cirro-cumulus, 6 to 7 km. The cirrus clouds generally drift towards W.S.W.; in April and May the drift is towards N.E. and N.W.: these two months agree with the cirrus-drift as observed at

Manila. During the months May to Sept. the cirrus-drifts and surface winds are directed fairly the same way at Batavia. The linear velocity of the cirrus ranges from 8 to 11·6 m./min., mean 7·8 m./min.; at Manila the mean velocity is higher, 11·6 m./min. H. B.

1375. *Sand carried into the Ocean by the Wind.* **Thoulet.** (Comptes Rendus, 146. pp. 1184–1186, June 1, 1908.)—The sea-bottom consists of foraminifera, clay, and minerals; the latter are partly of volcanic origin. The grains of quartz of various sizes which are always found in the samples in proportions of up to 80 per cent. are not volcanic, however, and not even ejected by submarine volcanoes. They must have been blown into the sea by the winds, and this conclusion should not be overlooked by geologists. The author experiments with quartz grains and vertical tubes, through which he sends air currents at velocities ranging from 0 to 18 m./sec., corresponding to winds from number 0 to 7 on the Beaufort scale. A calm of 1 m./sec. maximum will lift grains 0·08 mm. in diam., and a 18-m. wind will lift grains of 1·05 mm. Meteorological observations partly support these experiments, and we believe, moreover, that a wind of 10 m./sec. would sustain hailstones of 5 mm., and a wind of 25 m. hail of 20 mm. diam. H. B.

1376. *Further Observations on Etna.* **A. Lacroix.** (Comptes Rendus, 146. pp. 1184–1187, June 1, 1908.)—The author has examined the crater, starting from Riccò's observatory, situated at an altitude of 2,942 m. The vapour clouds again observed have a rolling motion as on Mont Pelée (St. Vincent); they leave a mud of very fine dust particles on the snow, but are cold and do not smell. The cleft has been traced further away; it is not radial to the crater. The crater itself was found less deep and wide than in 1905; it measures now about 800 m. maximum in diam. and 850 m. in depth. H. B.

1377. *Ablation of the Mer de Glace, Chamonix.* **J. Vallot.** (Comptes Rendus, 146. pp. 1855–1856, June 22, 1908.)—The ablation or level-change of glaciers is difficult to determine. The author has taken level observations on the Mer de Glace since 1891, and has collected other evidence, and arrives thus at two series of figures, resting on his own observations extending over nearly 15 years, and on less reliable records over 57 years. The corresponding mean ablation values of the two series are for different points: 11, 18·4, 19·8, 29·5 m., and 54, 55, 49, 74 m.; these observations concern altitudes up to 1,920 m. The polished spurs of the Aiguille de Dru, 8,755 m., show that the glacier ice crust there must have reached at the maximum of the glacial period 400 m. higher than the actual moraine. As his own observations show a relatively rapid wearing off of the ice, amounting to about 50 m. in 50 years, the author suggests that we are apt to overrate the length of the glacial period very considerably. H. B.

1378. *Mechanics of Igneous Intrusion.* III. **R. A. Daly.** (Amer. Journ. Sci. 26. pp. 17–50, July, 1908.)—The author explains on p. 19, and advocates throughout the paper, the hypothesis of magmatic stoping, namely, that each batholithic magma has reached its present position in the earth's crust largely through masses of the surrounding rocks falling into and being engulfed by the fluid magma; that is, the magma has not mainly *displaced* the older rocks, forcing them up and outwards, but *replaced* them. The sunken rocks are melted in the magma, forming with it a "synthetic" or secondary magma. The now visible rock of the granite batholith has resulted from the differentiation of such secondary magma. In evidence of his theory the author points out that the accessible surface of any granite or batholithic stock is generally dome-shaped, the cross-section enlarging with the depth—that masses of the older rocks, preserving their structure planes intact, are sometimes pendant into the crystallised granite—presumably because the fall of the masses took place when the granite or magma had ceased to be fluid enough for the mass to be engulfed and melted in it. It is never found, he says, that the magma has flowed over the older rocks—it has come up and taken their place. The hypothesis explains, he says, the common lack of chemical sympathy between granites and their respective enclosing rocks, though that might perhaps be equally well explained on the hypothesis of displacement. An objection by A. L. Day is considered, that rocks are good conductors of heat, and that therefore great differences of temperature could not long exist between the magma and the enclosing rocks. The author questions the fact as to the conductivity of rocks, and gives figures and references to Kelvin in support of his view, that the temperature gradient in the shell adjoining the molten magma must be very steep for many years after the original establishment of the contact; and this being the case, there will take place "contact shattering" through differential heating and expansion in the shell of older rock enclosing the molten magma. He considers also "the problem of the cover," which he admits to be a real objection to his hypothesis, namely, that the roof of the molten magma might be expected to "founder," that is, to break up and be engulfed altogether. The writer discusses the problem also in its relation to theories of the earth's internal heat. S. H. B.

1379. *Presence of Rare Gases in the Atmosphere at Different Altitudes.* L. **Teisserenc de Bort.** (Comptes Rendus, 147. pp. 219–221, July 20, 1908.)—Spectroscopic examination of samples of air collected at different heights from the earth, after either extracting the argon and rare gases by calcium, or eliminating the oxygen, nitrogen and argon by absorption by charcoal cooled in liquid air, has shown in all cases the yellow and principal red lines due to neon, and at altitudes up to 10 km. the yellow and some blue and green lines of helium. Above 14 km. no helium could be detected. Several of the lines observed in the spectrum of the aurora borealis are attributed to neon. W. H. Si.

1380. *Recent Determinations of the Solar Constant of Radiation.* C. G. **Abbott** and **F. E. Fowle, Jr.** (Annals of the Astrophys. Observatory of the Smithsonian Inst. 2. pp. 1–237, 1908. Terrestrial Magnetism, 13. pp. 79–82, June, 1908. Abstract.)—It is impossible here to do more than give the main points of the authors' summary and conclusions reproduced in the Abstract. This lengthy treatise is an account of the work done at the observatory from 1900 to 1907. The investigation dealt with is treated in three parts: First, the "solar constant of radiation"; second, the dependence of the earth's temperature on the amount of such radiation; third, the difference in brightness between the centre and edge of the sun's disc and its relation to the amount of solar radiation received. The experiments were made partly in Washington (sea-level) and partly at Mt. Wilson (1,800 m.). The radiation has been studied as a whole and also as dispersed, with due regard to wave-lengths above and below the visual limit. For all these rays the atmosphere has different degrees of absorption. The mean of 130 measurements on Mt.

Wilson gives the intensity of solar radiation outside the atmosphere as 2·028 gm.-cals./cm.^{2} per min.; of 41 at Washington, 2·061 gm.-cals. Thus 2·1 cals. can be taken as a probable mean value in round numbers. It is shown that these results are really in agreement with those of Langley, as he should not have applied his correction for systematic error, which does not exist. The intensity of the solar radiation is not constant. On Mt. Wilson the values range from 1·98 to 2·14 cals., and in Washington from 1·89 to 2·22. The decrease in solar distance (Aug. to Oct.) produces a change of 3½ per cent. in the solar radiation, so that the large changes observed must be really solar changes. The earth's temperature is in good agreement with the value 2·1 cals. for the solar constant; in fact, the mean value cannot exceed 2·88 cals. unless the albedo of the earth exceeds 37 per cent. or the earth radiates better than the "absolutely black body." Radiation to space can only be small. The maintainer of the earth's temperature is the water-vapour layer at 4,000–5,000 m. elevation, whose mean temperature is about −10° C. [In an addendum published separately the authors call attention to errors in their statements which are based upon the reflecting power of clouds.] L. H. W.

1381. *Longitude Determination by Moon Observations.* **C. V. Boys.** (Nature, 78. p. 152, June 18, 1908.)—An extended article on the method of determining longitudes in the field by observations of the moon, which has been elaborated by E. B. H. Wade. As the method of lunar distances is much less sensitive to errors of time than the method of moon culminations, this has been selected, and the method under review is a refinement of the usual proceeding, enabling a much higher degree of accuracy to be obtained. The instrument employed consists of a telescope of 2½ in. aperture and magnifying power about 40, carrying a reflector set at 45° in front of the object-glass. The telescope is always horizontal, and can rotate upon its longitudinal axis as well as upon a vertical axis in azimuth. Outside the first reflector a second is adjusted so as to cover only half the field of the objective, and this receives light from a third. This second pair of reflectors may be either parallel or at a definite fixed angle to the first, and they may be rotated by means of a worm gear from the eyepiece. By these means the exact moment when a star is tangential to the moon's limb may be determined with a probable error of only 1·5 sec. of longitude. C. P. B.

1382. *Helium Absorption in Sun-spots.* **R. A. C. Daunt.** (Roy. Astronom. Soc., Monthly Notices, 68. pp. 620–625, June, 1908.)—List of observations of dark D_3 helium lines in sun-spot spectra made during 1907. Throughout the work the dark line was never seen over the umbra or penumbra of the spots, but between them or on the photosphere in their neighbourhood. In every case of observation of reversal of D_3, the Hα line of hydrogen was sympathetically affected, being twisted and lumpy, distorted towards the red and violet, accompanied by brilliant reversals, sometimes over considerable areas. A most useful item of information with these observations is the classification of the spot-groups observed according to Cortie's nomenclature, in order to ascertain if the phenomenon of D_3-absorption is associated with any particular phase in the life-history of spot-formation. From the analysis it appears that the phenomenon is indicative of violent local action in the earlier history of the spot group; the groups in which the dark line was not observed were usually in the last stages of their development, but exceptions occurred to both these general conditions. C. P. B.

1383. *Hydrogen Flocculi photographed in Hα and Hδ.* **G. E. Hale.** (Comptes Rendus, 146. pp. 1251–1254, June 15, 1908.)—For some time past spectroheliograms have been regularly taken in hydrogen light using the Hδ line, and in March, 1908, it became possible to obtain comparative pictures in the C line, Hα. It has long been known that this line showed variations which were not indicated in the other hydrogen lines, and these recent photographs show a great amount of detail not present on the Hδ plates, permitting a more complete study of the solar atmospheric circulation. On April 30, 1908, a solar storm of very great extent was thus photographed, giving distinct evidence of vortex motion. C. P. B.

1384. *Rotation and Brightness of Solar Atmosphere.* **H. Deslandres.** (Comptes Rendus, 146. pp. 1235–1241, June 15, 1908.)—An investigation of the solar rotation by measuring the inclination of the spectral lines produced when the spectroscope slit is adjusted parallel to the equatorial diam. of a small image of the sun projected on the slit-plate. The method is rendered more accurate by using a reversing prism, and thus getting two spectra with lines inclined in opposite directions. The preliminary results show by inspection differences in rotation of the various solar layers as indicated by the several lines of calcium, hydrogen, cobalt, iron, &c., examined. Thus the higher calcium layers show less inclination than the Co and Fe lines of the reversing layer. At times, however, these conditions are considerably modified. For determining the variations of brightness of the chromosphere it is proposed to take comparison spectroheliograms on the same plate, one image in K_2 light of calcium, the other in the continuous radiation between any two predetermined dark lines. C. P. B.

1385. *Prominence and Coronal Structure.* **W. J. S. Lockyer.** (Nature, 78. pp. 174–175, June 25, 1908.)—The writer has previously drawn attention to a peculiar form of prominence which had been photographed at the Solar Physics Observatory in the "K" light of calcium [see Abstract No. 729 (1908)]. This prominence, situated towards the south pole of the sun in the eastern quadrant, about position angle 137°, was recorded on two separate negatives at an interval of 36 min. Although other prominences were also visible on the photographs, no special attention was drawn to them, as they were of the common type. The presence of one such prominence, a fairly large one, on the south-western quadrant, has raised questions of identity, hence a photograph of the complete limb of the sun is now reproduced, instead of the partial limb only. This clearly establishes the relationship between the two prominences. In a communication from P. Fox of the Yerkes Observatory, U.S.A., which Lockyer received in April last, mention is made of a peculiar prominence observable in the south-west quadrant on July 17, and the suggestion is given that perhaps Lockyer has mistaken the quadrant. As a matter of fact, however, the prominence referred to by Fox is not the one about which the paper was written. The reason that there has been doubt on the subject, Lockyer puts down to the fact that the disturbance lasted for a very short time, as the destruction of the arches was clearly visible on the second photograph. **P. Fox.** (Ibid. p. 318, Aug. 6.) W. J. C.

1386. *Observations of the Partial Eclipse of the Sun, June 28, 1908, at Paris.* **B. Baillaud.** (Comptes Rendus, 146. pp. 1359–1360, June 29, 1908.)—Observations of the eclipse were made with the East and West equatorials and their finders, with the coude, and with the photographic equatorial.

With the West equatorial the spiral diaphragm proposed for the transit of Mercury was employed. Puiseux reported that the sun's limb was excessively agitated at the moment of first contact, and that his observation of this contact was doubtless 7 or 8 sec. too late. The undulations of the limb, which were ample and rapid, with production of luminous filaments, had a perfectly definite direction, this direction being the same for points of the image diametrically opposite. He notes that the yellow fringe, due to the employment of a photographic objective achromatised for the G line, was always wider at the eclipsed part of the solar border than at the clear part. Several plates were taken between the two contacts without the interposition of coloured glasses; examination will show whether they reveal an analogous difference. Bigourdan took measures of the length of the common chord of the two discs, the max. length of which was about 18 min., and read the corresponding position angles. A score of photographs, on plates with reticule, were taken by Baillaud. A. E.

1387. *History of Lunar Relief.* **P. Puiseux.** (Comptes Rendus, 147. pp. 113–116, July 13, 1908.)—In the preparation of the tenth volume of the *Atlas photographique de la Lune*, shortly to be issued by the Paris Observatory, numerous points have been raised owing to the richness of material provided by photographs of greater clearness. A special discussion is given of the peculiar features of the lunar formations near the North Pole, where there is evidence of the deformation of a thin crust, an appearance which has in other regions been subsequently marked by greater eruptions. On both the earth and moon the variations of level appear to have a definite relation to the latitude, but this need not mean that two places antipodal to each other have had the same physical history. C. P. B.

1388. *The Lunar Bright Rays.* **H. G. Tomkins.** (Roy. Astronom. Soc., Monthly Notices, 68. pp. 571–573, June, 1908.)—The author advances a new theory of the lunar bright rays, based on terrestrial analogy. He suggests that their configuration and albedo may have independent causes. Taking the albedo first, it may be explained on the supposition that the white material consists of soluble salts of sodium and other minerals. In the case of the earth, these salts are brought to the surface by evaporation in many parts of the globe, such as the arid alkali tracts of North India and Persia. Originally existing below the surface, either as beds of solid salt or salt-impregnated strata, when they come into contact with the subsoil water they rise to the surface in solution, and, on the water drying, are left as a white efflorescence. The configuration of the deposit depends on that of the ground. Radial configurations can be traced in many volcanic regions of the earth. They are due to intrusion of liquid matter from below, which, by pushing up a centre of volcanic activity, causes the formation of radial fissures, and upheaval of strata round it. They are not always visible on the surface. If such upheavals occurred in the neighbourhood of saline deposits, the saline strata would be pushed upwards along with other strata, and this would bring them within reach of evaporation at those places, and result in efflorescence on the surface, which would follow the direction of the upheaval, and a radial formation would thus occur. On the moon all the conditions for such a state of affairs exist. The moon having probably once been part of the earth, the existence thereon of sodium and other terrestrial minerals is to be expected. Though water, in its free state, does not exist on the lunar surface, there is no reason why it should not once have existed in the soil, and, with the lunar climate, there would have been strong evaporation at some time. Consequently any soluble salts in the crust would come to the surface, and owing to the absence of clouds or rain, which might temporarily reverse the process of evaporation, the salts would rise more or less continuously, would remain permanently on the surface, and follow the configuration of the ground. If on the earth water and rain were to disappear from the surface, a similar state of things would ensue, and, in addition to the countries now affected, the areas occupied by the ocean would have to be taken into account, with the enormous quantities of salts at present in solution. An objection to the above explanation is the invisibility of the lunar rays when the sun's altitude is low (according to W. H. Pickering under 5° or 10°), which has been regarded by some as indicating physical change of material. This invisibility, however, may be explained on the ground that there is little or nothing except their albedo to notify the presence of the rays, and that a fair amount of illumination is required to produce a contrast between the white material of which they are composed and the surrounding country. **A. E.**

1389. *Photographic Determination of Elements of Orbits of Jupiter's Satellites.* **B. Cookson.** (Roy. Soc., Proc. Ser. A. 80. pp. 567–572, June 20, 1908.)—In 1902 the writer made a series of measures of the four large satellites of Jupiter, with the 7-in. heliometer at the Cape Observatory, in order to determine the mass of Jupiter, and to correct the best available elements of the orbits of the satellites. Simultaneously with the visual observations, photographs were taken with the astrographic telescope, with the object of testing whether photography would yield as accurate results as the heliometric method. The agreement between the visual and photographic results was found to be satisfactory; many of the unknowns did not differ by more than their probable errors, and the numerical results are in general the same. In point of accuracy, as measured by interagreement of the observations, the photographic method is more accurate than the heliometric. The probable error of a visual observation of weight unity is about ± 0″·095, and that of a photographic ±0″·061 or less. But perhaps the heliometer is superior in its more probable freedom from systematic error; in measurements of absolute angular distances the heliometer is to be preferred. The mass of the system of Jupiter, in terms of the sun's mass, was determined with great care from heliometer observations of the distances of the satellites from the planet and their times of revolution. The value finally deduced is 1 : 1047·30 ± 0·06. The uncertainty in the position of Jupiter's centre, arising from the ill-defined image of the disc on the plate, was eliminated by a process of successive approximation. The observations were compared with Souillart's theory. Marth's tables (Roy. Astronom. Soc., M.N. 51) were used, with certain corrections, for calculating the values of the longitudes and radii vectores. The values of the masses of the satellites are still very doubtful, those of satellites I and IV even to the extent of 50 per cent. The writer quotes values of $\epsilon_1 - 3\epsilon_2 + 2\epsilon_3$ found by him, but remarks that it is not yet safe to conclude that they are wholly due to Laplace's libration; it must first be ascertained that the quantities ϵ_1, ϵ_2, ϵ_3 include no erroneous or unknown inequalities in longitude. This would entail a revision of the whole theory of the satellites. Observation is thus in advance of theory. Heliometric and photographic measures are of more value than photometric measures of eclipses in determining the positions of the satellites' orbits. It is of interest to determine the motion of the node of the second satellite on Jupiter's equator. As is well known, the effect of an equatorial bulging of the primary is to cause a retrograde motion of the node of a satellite's orbit along the equator of the primary. The writer gives a small table showing the motion of the nodes of the satellites due to the compression of Jupiter, &c. The motion of the node of satellite II is measurable, and affords the best means of finding the physical compression of Jupiter. Barnard's fifth satellite is so near to the primary that the node of its orbit revolves 912° per annum. A careful measurement of this motion would be of much value, since a comparison of the compression of Jupiter deduced from the motion of the node of V with that deduced from the node of II might furnish information concerning the distribution of mass in Jupiter. A. E.

1390. *Albedoes of Jupiter's Satellites I and III.* **F. Quénisset.** (Soc. Astronom. de France, Bull., July, 1908. Nature, 78. p. 255, July 16, 1908. Abstract.)—Observations made at Juvisy during Jan. and March, 1908, show that the surface luminosities of Jupiter's first and third satellites are relatively low. The disc of Ganymede when seen outside the planet was quite brilliant, but when projected on the surface of the planet during a transit it became darker and darker, until when near the central meridian it appeared almost as dark as its own shadow. C. P. B.

1391. *Observations of Saturn's Rings.* **W. H. Wright.** (Astrophys. Journ. 27. pp. 368–371, June, 1908.)—Commenting on Barnard's article on the appearances presented during the last disappearance of Saturn's rings [Abstract No. 571 (1908)], the author considers it improbable that any illumination as strong as that involved in the outer beads could be due to percolation of sunlight through the interstices between the meteoric particles constituting the rings. An analysis is then given supporting the theory of Bond to account for the knots observed on the rings during disappearance. C. P. B.

1392. *Photometric Measurements of Neptune.* **J. M. Baldwin.** (Roy. Astronom. Soc., Monthly Notices, 68. pp. 614–620, June, 1908.)—A series of observations made at the Astrophysical Observatory, Potsdam, to ascertain whether it were possible to recognise a short-period variation in the brightness of Neptune such as that suspected by Maxwell Hall in 1883 and 1884. No such variations were detected, and it is shown that the appearances suspected were within the errors of observation. This means that the time of rotation of 7·92 hours deduced from the supposed variations must be abandoned. The observed magnitude of Neptune at mean opposition is 7·99 on the Potsdam Durchmusterung scale. C. P. B.

1393. *Remarks on Lebedew's Note: "Apparent Dispersion of Light in Interstellar Space."* **G. A. Tikhoff.** (Comptes Rendus, 147. pp. 170–173, July 20, 1908.)—The author reduces Lebedew's objections [see Abstract No. 1242 (1908)] to the following four main statements, and then deals with each in turn: (1) If Nordmann and the author's observations be explained by cosmic dispersion, the said dispersion is comparable to that of atmospheric air at 7 mm. pressure, and at 0° C. (2) The explanation by dispersion is not admissible, because it is contrary to prevailing theories. (3) It is possible to give another explanation based on the physical properties of variable stars. (4) The method of observation of minima in different rays cannot be of service in investigating the dispersion. *Reply*: (1) The parallax of the star RT Persei has just been investigated at Pulkowa and found to be negligible ($\pi = -0''\cdot085 \pm 0''\cdot016$). The star at maximum is of the 10th magnitude, and its distance may therefore be taken as the average of stars of this magnitude, which according to Kapteyn is 740 light-years. Now the shift found between the minima for 480 $\mu\mu$ and 560 $\mu\mu$ is 4 min. for a wave-train, or 80 sec. for a single wave. If the shift is due to cosmic dispersion, the difference of velocity of these rays would therefore be $80 \div (740 \times 365 \times 24 \times 60 \times 60) = 3 \times 10^{-9}$ of the velocity of light, or 1 m. per sec. But the difference of velocities of these rays in air is 870 m. per sec., so that this star only gives a dispersion 0·001 of atmospheric. This result, however, can only be regarded as provisional, owing to uncertainty in the data. (2) History shows that the idea of the absence of dispersion in the interstellar medium had its rise in astronomical observation. It is important, therefore, to pursue observations, or investigation, of cosmic dispersion as methods increase in accuracy. The last word on the theory of light has not yet been said. (3) In the author's opinion, the number of stars observed, and of regions studied in their spectra, are too few for a useful judgment to be based upon them. Even if Lebedew's explanation be right in principle, one might just as well apply it the other way, and assert that the asymmetry of the atmosphere of the satellite diminishes the effect of dispersion and renders the observed shifts smaller than they otherwise would be. Further, even if Lebedew's explanation be applicable to the stars RT Persei, Algol, and λ Tauri, where an eclipse is certain, it would be necessary to invent another for W Ursæ, which varies continuously, and for β Aurigæ, observed spectroscopically. (4) It is possible in certain cases to distinguish between different influences of which we only observe the algebraic sum. There are two important properties which would mark displacements arising from cosmic dispersion: (1) They would be proportional to the distances of the stars. (2) For each star, they would be represented by a continuous function of the wave-length, the same for all stars (disregarding possible inequalities in different parts of space). Thus there is already difficulty in reconciling the observed displacements from the dispersion standpoint. Judging from their parallaxes, it is almost certain that RT Persei is more distant from us than Algol, while from the displacements of the minima, Algol should be three times as distant as RT Persei. Thus the facts already point to an influence other than dispersion. The important point, however, is not to seek explanations, but to increase the number and precision of the observations. A. E.

1394. *New Peculiarities of Variable Stars of Short Period: Method of Distinguishing their Effects from those of Dispersion in Space.* **C. Nordmann.** (Comptes Rendus, 147. pp. 24–27, July 6, 1908.)—In order to explain the relative displacements of the minima, relative to different wave-lengths, observed in certain variable stars by Tikhoff and the author, Lebedew has advocated the possibility of a physical dissymmetry in the atmosphere of the satellite [see Abstract No. 1242 (1908)]. The author's object is to show that such a hypothesis is unnecessary, and that, by considering only gravitation and the viscosity of these stars, the separation of minima may be accounted for by general causes, which he indicates, existing in the star-system. He starts by enunciating the following principle: "Any difference between the velocity of rotation of the principal star and the angular velocity of revolution of the satellite, as well as any relative variation of these two velocities, should, other things being equal, produce separation between the minima of the light-curves of the star relative to different regions of the spectrum." The proof he bases on the following considerations; Σ here denoting the principal star, and σ the satellite: (1) Such differences or variations of velocities will, owing to Σ's viscosity and tendency to maintain a uniform rotation, cause the tide produced by Σ on σ to be displaced relatively to the line of centres. (2) The apparent minimum, relative to a particular radiation of the star, occurs when the projection of the line of sight on the orbit of σ coincides with a certain right line which is the resultant of two vectors drawn from Σ: one directed along the line of centres at the moment of central eclipse, and representing the maximum obscurity due to the interposition of σ; the other in the direction of the atmospheric protuberance due to the tide, and representing the maximal absorption by the star's own atmosphere of the particular radiation considered, the magnitude of this vector being dependent upon the radiation. (3) Hence, the direction of the resultant also depends upon the radiation. Q.E.D. The following are deductions from the above proposition. (Their proofs will appear, with numerical applications, in a detailed memoir.) Let m_1, m_2 be the epochs of minima of the star for two radiations λ_1, λ_2, of which λ_1 is the more strongly absorbed by its atmosphere. If σ revolves more rapidly than Σ rotates, m_2 will precede m_1, and *vice versâ*. If the two periods are equal, then the orbit, owing to its eccentricity (0·15 for Algol), will be divided into two unequal regions with different properties, and m_2 will precede or follow m_1 accordingly as the apparent minimum of the variable star occurs in the region containing periastron, or in that containing apastron. The unexpected conclusion is thus reached that, for a given star, the answer to the question whether the minimum observed in the red will precede or follow the minimum in the blue, depends upon the orientation of its orbit in space. On considering the tides raised upon the satellite by the principal star, similar reasoning will apply, but λ_1 and λ_2 must be interchanged in the results. Which effect will predominate in the light-curve of the system must depend upon circumstances. In the case of stars of the Algol type the author points how his "method of monochromatic images" [see Abstracts Nos. 590, 786 (1908)] may afford a means of discriminating between the effect of dispersion in space, and the combined effect of the above causes and that suggested by Lebedew. The relative retardation or advance of two radiations, due to dispersion in space, for a star of this type has evidently the same duration whatever be the phase of variation of the star. Therefore the shift thus produced between the two corresponding light-curves will commence and cease abruptly with the luminous variation. On the other hand, a shift due to causes in the star system itself, such as the above mentioned, will increase and decrease gradually during the minimum, and vanish at the beginning and end of the luminous variation. Hence study of the monochromatic light-curves obtained would afford a geometric means of separating the effects. The author, however, remarks that the few observations obtained as yet by Tikhoff and himself are not yet sufficient for the application of this criterion. A. E.

1395. *Radial Velocities of Second- and Third-class Stars.* **F. Küstner.** (Astrophys. Journ. 27. pp. 301–324, June, 1908.)—From photographs obtained during the period 1903–1907 with the 30-cm. photographic Repsold-Steinheil refractor at Bonn, the author has determined the radial velocities of 99 stars of the second and third spectral classes. The spectograph has three prisms of 60° angle, set at minimum for Hγ, and giving a dispersion of 15·2 tenth-metres per mm. at Hγ. Electric adjustment for constant temperature was employed, and for comparison the iron arc diffused by a ground-glass disc.

The values obtained are tabulated, with details of spectral class, photographic magnitude, &c. Comparison spectra for adjustment of constants have been made by photographing the spectra of the small isolated points near the moon's terminator. C. P. B.

REFERENCES.

1396. *A Differential Volumenometer.* **A. P. Carman.** (Phys. Rev. 26. pp. 396–398, May, 1908.)

1397. *New Actinometer.* **W. A. Michelson.** (Phys. Zeitschr. 9. p. 18, Jan. 1, 1908. Meteorolog. Zeitschr. 25. pp. 246–253, June, 1908. Extract.)—Description of a direct-reading actinometer in which the receiving mechanism is a thin lamina of platinum and copper, enclosed in a massive copper cylinder which is again protected from direct solar radiation by an outer vessel. C. P. B.

1398. *Hamilton s Principle and the Five Aberrations of von Seidel.* **Rayleigh.** (Phil. Mag. 15. pp. 677–687, June, 1908.)—Unsuitable for abstracting.

1399. *Bending Moments at the Points of Support of Continuous Beams.* **J. H. Smith.** (Engineering, 85. pp. 839–840, June 26, 1908.)—A general method is given which enables one to obtain the bending-moment diagrams for all possible cases.

1400. *Combined Stresses.* **C. A. Smith.** (Engineering, 86. pp. 27–29, July 10, 1908.)—Discusses present knowledge of the subject, with particular reference to the effect upon design of using Guest's law [Phil. Mag., 1900, and Abstract No. 2128 (1900)], *i.e.*, that a member subjected to combined stresses fails under the max. shear, as compared with Rankine's (max. tension) and St. Venant's (when the strain exceeds a certain limit). An outline of Guest's experiments is given. F. R.

1401. *Elastic and Magnetic After-effect (Hysteresis).* **H. Tobusch.** (Ann. d. Physik, 26. 3. pp. 439–482, July 7, 1908.)—A research with the object of finding whether magnetic and elastic after-effects obey the same mathematical laws. A sketch of Wiechert's theory is first given. Afterwards experiments on the deformation of spiral springs and the magnetisation of iron rods are made, in each of which the decay of the after-effect with time is noted. Wiechert's theory is found to be in good agreement with experiment as regards both classes of after-effect. G. E. A.

1402. *Limiting Speed of Vehicles Moving on Curves.* **A. Gray.** Eng. Rev. 18. pp. 391–393, June, 1908. Paper read before the Roy. Philosophical Soc., Glasgow.) —A brief discussion suggested by the Salisbury accident. L. H. W.

1403. *Temperature and Structure of the Sun.* **O. Lummer.** (Phil. Soc. Washington, Bull. 15. pp. 75–101, May, 1908.)—Review of work during last quarter of century on the theoretical and practical evaluation of temperature, dealing specially with the development of the "black body" standard of radiation. Temperature of sun is given as 5,880° abs. from one method, and 7,000° abs. from another. Prominence is given to the supposed influence of anomalous dispersion on the appearance of solar phenomena. C. P. B.

1404. *Solar Constant.* **H. H. Kimball.** (Monthly Weather Rev. 36. pp. 108–110, April, 1908. Paper read before the U.S. Weather Bureau Committee, April 29, 1908.)—An attempt is made to develop an empirical formula by means of which the solar constant may be computed from pyrheliometric observations with an accuracy comparable with that of the observations themselves. Comparisons are given of the results obtained by pyrheliometric measurements at Washington and bolometric measurements at Mount Wilson and the Smithsonian Institution, showing very close agreement in many cases [see Abstract No. 1380 (1908)]. C. P. B.

LIGHT.

1405. *Largest Reflecting Telescope in the World.* **G. A. Thompson.** (Scientific American, 98. pp. 409–410, June 6, 1908.)—Harvard University Observatory has just completed the mounting of a 5-ft. reflecting telescope, purchased from the estate of the late A. A. Common. Only the principal portions of the original telescope have been used. Instead of being supported by a rigid pier, the telescope is attached to a hollow cylinder that floats in a tank of water. The tank has thick walls of concrete, and is 15 ft. deep at the deepest part, and 21 ft. long. Its bottom, which is shaped to fit the lower portion of the cylinder, slopes upward at 45° from the deepest point. In this tank the water-tight steel float or cylinder, which is 18 ft. long by 7 ft. 8 in., is ballasted at the same angle, which is the angle of elevation of the celestial pole at Cambridge, Mass. The cylinder, which serves as the polar axis of the telescope, revolves upon two delicate pivots at the extremities of its axis, the buoyancy of the water relieving the pivots of the weight. The rectangular tube of the telescope is attached to a strong fork on the upper end of the cylinder, and its upper part, for a distance of 15 ft., is a skeleton framework of angle iron, with an inside diameter of 6 ft., now covered with canvas. The lower end, which contains the mirror, is a hollow 6-ft. cube with sides made of steel plates. The whole structure weighs over 20 tons. For several years all the clockwork for driving the telescopes at Harvard has been driven by electric motors, by means of mechanism devised by W. P. Gerrish of that observatory. In the case of the Common telescope, electric power is applied, not only to the clockwork, but to the mechanism for handling. The eyepiece, which is detached from the telescope and looks down into an aperture in the side of the tube, is situated at a desk in a projecting bay of the observing-room, which forms the upper storey of a small building. Switches at the same desk control motors and clutches by means of which the telescope may be swung at different speeds. A small motor synchronised by an accurate clock gives a uniform motion for following, while dials and indicators show the position and motion imparted to instrument. Other dials register automatically the measures made by photometric apparatus. On the ground floor, under the observing-room, is the silvering-room, where the great mirror, which is a glass disc 5 in. thick and 60 in. in diam., weighing with its cell nearly 2 tons, may be rolled in on rails to the silvering table when it requires recoating. The telescope is mounted in the open air. The Common telescope is a modified form of Cassegrain, the rays from the large mirror being reflected back to a small convex mirror, and thence back again to a third mirror, placed diagonally, which sends them through a side aperture to the eyepiece. The work to which it has been assigned at Harvard is photometric. The reflector is expected to show stars of the 17th or 18th magnitude, or fainter, thus opening a wide new field for investigation. A. E.

1406. *Optics and Glass-smelting.* **E. Zschimmer.** (Zeitschr. Instrumentenk., Beib. 12. pp. 113–115, June 15, 1908.)—Remarks upon the present position of the glass manufacturing industry. Up to the present about ten different classes of chemical substances in the form of optical glass have been prepared. *Old kinds of glass:* (1) ordinary silicate crown, (2) ordinary silicate flint. *New Jena glasses:* (3) barium and zinc silicate crown, (4) borosilicate crown, (5) heavy baryta crown, (6) baryta flint, (7) telescope flint (antimony flint), (8) borosilicate flint, (9) borate glasses, (10) phosphate glasses. The following are the optical constants of some of the chief types of glass :—

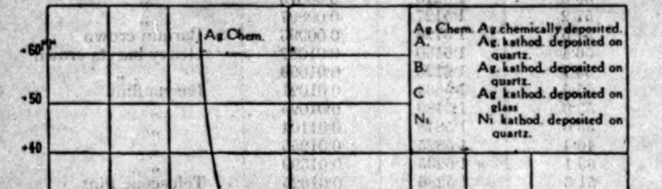
$\nu = \frac{n_D - 1}{C - F.}$	Refractive Index n_D.	Mean Dispersion C − F.	Kind of Glass.
64·1	1·5141	0·00802	Borosilicate crown
63·4	1·5108	0·00805	”
60·4	1·5191	0·00860	Silicate crown
59·6	1·5215	0·00875	”
57·2	1·5127	0·00897	”
57·5	1·5726	0·00995	Barium crown
56·4	1·6130	0·01087	Heavy baryta crown
55·7	1·6120	0·01099	”
55·5	1·5664	0·01021	Baryta flint
53·6	1·5489	0·01025	”
53·0	1·5848	0·01104	”
46·4	1·5825	0·01255	”
39·1	1·6285	0·01599	”
51·6	1·5286	0·01025	Telescope flint
41·1	1·5794	0·01409	Silicate flint
36·9	1·6138	0·01664	”
33·8	1·6489	0·01919	”

J. J. S.

1407. *Refractive Indices of Alcohol-Water Mixtures.* **L. W. Andrews.** (Amer. Chem. Soc., Journ. 30. pp. 353–360, March, 1908. Contribution from the Laborat. of the Mallinckrodt Chemical Works.)—Absolute alcohol prepared by the use of calcined marble and freed from aldehydes has the same density, 0·78510 at 25°/4° (weights not reduced to vacuum), the same refractive index 1·35941 at 25° (hydrogen scale), and the same critical temperature of solution (4° C.) as alcohol dried by magnesium amalgam or by calcium. The C.T.S. method of testing (mixing with kerosene and noticing temperature of separation) is the most sensitive for detecting moisture. The index of refraction reaches a maximum at 20·7 per cent. H_2O, corresponding with the formula $C_2H_6O, 1·5H_2O$, but, in the strongest solutions, changes rapidly, and is then a more sensitive test of dryness than the density. T. M. L.

1408. *Perception of Relief and Depth in the Simple Image of Ordinary Photographic Prints.* **A. Chauveau.** (Comptes Rendus, 146. pp. 725–730, April 6, 1908.)—The same sense of relief and depth which is obtained from the two prints of a stereoscopic photograph can be obtained from a single print. It is only necessary that the two retinal images should be dissociated through the cessation of convergence of the optical axes. Methods by which this result can be accomplished are described; the simplest method (though one requiring practice) consists in examining a print with the eyes fixed on a point beyond. H. W. P. Y.

1409. *Reflection from Thin Metallic Layers.* **C. Fabry and H. Buisson.** (Journ. de Physique, 7. pp. 417–429, June, 1908.)—In all measurements made by means of interference produced by silvered plates there is introduced, for each radiation, a difference of path between the directly transmitted ray and that which has undergone two reflections. The optic thickness of an air-plate is, by definition, the half of this difference of path for normal incidence. When the air-plate is bounded by glass surfaces the thickness thus defined is equal to the distance between the material surfaces; but when it is bounded by silvered surfaces this is not the case, because of the change of phase which occurs on reflection from a metallic surface. Instead of considering this change of phase, one can suppose that the reflection is produced by a glass surface slightly displaced from the silvered surface. This surface can be called the *optic surface* of the silvered glass. In the case of interference with silvered plates the optic thickness of the air layer is equal to the distance between the two optic surfaces. The actual distance between the two silvered plates is not required; it differs very little from the optic thickness, and this difference (twice the distance between the optic surface and that of the metal) is of the order of several $\mu\mu$. The optic surface is not the same for all radiations. It is therefore necessary to take account of the variation of the optic thickness with varying wave-lengths. This is the subject of the present paper. The method of measurement results immediately from the definition. Having produced interference with two radiations of wave-lengths λ and λ', the orders of interference q and q' are measured at the same point. The wave-lengths being known, the corresponding optic thicknesses e and e' are given by $2e = q\lambda$, $2e' = q'\lambda'$. Denoting by ϵ the difference of the double thicknesses, we have $\epsilon = 2(e - e') = q\lambda - q'\lambda'$; $\epsilon/4$ represents the dis-



tance between the optic surfaces for the two radiations if the silvered surfaces are identical. Three methods of measurement were adopted, and the results for the different surfaces studied were all reduced to the wave-length 5460, which was taken as the standard. Curves were then obtained showing for each wave-length the difference $(2e - 2e_{5460})$. The surfaces used were obtained in different ways, and the variation of the optic surface evidently depends on the method of deposition of the metal. With a pair of mirrors obtained by Martin's process of deposition on quartz the reflecting power for the green mercury line was 0·85, the transmitting powers were 0·017 and 0·015. The thickness of metal was about 60 $\mu\mu$. For these silvered plates the optic thickness of a layer of air increases as the wave-length diminishes. This result is of the same sense and of the same order as that which had been previously obtained by Perot and Fabry for plates of the same kind by means of observations solely in the visual spectrum. The variation becomes very rapid when the wave-length reaches 3300, *i.e.*, about the region where the reflecting power of the silver diminishes rapidly. Other mirrors were obtained by kathodic projection. Some of these behave like chemically silvered plates with respect to change of phase and reflecting power. Others have altogether different properties: the optic thickness varies in the opposite sense, and their reflecting power does not show the minimum so noticeable with chemically silvered plates. Three pairs of plates of this kind were studied. Another pair of quartz plates were coated with nickel by kathodic projection, and these showed a slow increase in the optic thickness with decreasing wave-length. The accompanying Fig. shows the results obtained. Houllevigue has recently shown that gold can be deposited in two states from a kathode, and has studied the conditions of the production of the two varieties. It appears probable that the same occurs in the case of silver. A. W.

1410. *The Effect of the Position of the Grating upon the Resolving Power of a Spectroscope.* **A. W. Porter.** (Phil. Mag. 15. pp. 762–764, June, 1908.)—This paper is an extension of one by H. Morris-Airey [see Abstract No. 708 (1906)], in which it was shown that even wide slits may be employed if the light fall at nearly grazing incidence upon a grating or prism. But the closeness together of two spectral lines of different wave-length also varies with the position of the grating, and it is necessary to examine the variation of this proximity before it can be definitely decided that a gain in purity is obtained by inclining the grating or prism. In this paper the case of a grating is considered in detail. J. J. S.

1411. *Rotation of Falling Prisms.* **W. Köppen.** (Meteorolog. Zeitschr. 25. pp. 280–288, June, 1908.)—A paper dealing with the theory of halo phenomena. Arrhenius stated that crystals falling through the air would so set themselves as to experience the least possible resistance. More recently Pernter [see Abstract No. 2056 (1907)] arrived at the same conclusion from purely optical considerations. The author, however, finds by experiment that falling prisms set themselves so as to experience not the least, but the greatest resistance. With long crystals the axis is horizontal in falling, and they acquire a rotation some little time after the commencement of the fall. The nearer the cross-section of the prism approximates to the form of a circle the later does the rotation commence. If the prism is in the form of a plate the rotation is considerable, and the path makes a large angle with the vertical. When the plate has a slight convexity it falls with the convex side underneath, and if sufficiently stiff, descends vertically. So ice-crystals of prismatic form rotate in falling about their principal axis, which is horizontal, while snowflakes in the form of little plates rotate about the longest horizontal axis, which is one of the secondary crystallographic axes. The halo phenomenon can be explained, then, by supposing the air to be filled with these rotating ice-cylinders, the axes being horizontal, but having all possible azimuths. Wood [Abstract No. 192 (1907)] has also shown that falling crystals descend so as to experience maximum air-resistance, and he also found that the long axis of such crystals was horizontal. A. W.

1412. *Magnetic Rotation of the Plane of Polarisation in the Ultra-violet.* **S. Landau.** (Phys. Zeitschr. 9. pp. 417–431, July 1, 1908.)—Some accurate observations of the rotation of the polarisation plane in magnetic fields with uviol glass, water, alcohol, fluorspar, and rock-salt. It was found that the general formula deduced from the electron theory agrees very closely with the observed results, although the observation sometimes gave negative results instead of positive. This last fact is most readily to be explained by positive electrons. The Becquerel formula $\lambda dn/d\lambda$ agrees well with the observations in the cases of fluorspar and rock-salt. The values of ϵ/μ were found to decrease with decrease of wave-length, which cannot be explained by the existence of electrons with smaller frequencies. E. C. C. B.

1413. *Dispersion in Highly Absorbing Media studied by means of Channeled Spectra.* **S. R. Williams.** (Phys. Rev. 27. pp. 27–32, July, 1908. Paper read before the Amer. Physical Soc., Feb., 1908.)—Light fell upon a thin wedge-shaped film of the substance, and the two beams reflected from the front and back surfaces respectively illuminated the slit of a grating spectrometer. In the resulting spectrum interference occurred according to the formula $(2N + 1)/2 = 2\mu d/\lambda$, where N is the difference in path in wave-lengths, μ the index of refraction, d the absolute thickness, and λ the wave-length. If the interference bands from two solutions be compared in the same part of the spectrum their relative dispersion will be obtained from the relative position of the bands in the two spectra. The comparison is made by placing the two solutions in the same cell, one above the other, with a dividing strip between them. No evidence of anomalous dispersion was found with very weak solutions in alcohol of fuchsin, cyanin, litmus, eosin, and napthalene red. To determine the strengths of solution at which the anomalous dispersion of fuchsin appears, four solutions were compared containing 0·0000244, 0·000049, 0·000072, and 0·000096 gm. to 1 gm. of alcohol respectively. A comparison of the last two strengths showed a decided difference in the relative positions of the interference bands, the shift being towards the red between $\lambda = 5896{\cdot}1$ and $\lambda = 5528{\cdot}6$, and towards the blue between $\lambda = 5447{\cdot}0$ and $\lambda = 4883{\cdot}7$. The results show that the dispersion of fuchsin solutions possesses maxima and minima, or, in other words, that the absorption band is made up of several closely situated maxima. E. C. C. B.

1414. *Production of Spectra by an Electrical Furnace in a Hydrogen Atmosphere.* **A. S. King.** (Astrophys. Journ. 27. pp. 353–362, June, 1908.) —The method employed was to pass a heavy alternating current through a graphite tube placed in an air-tight chamber filled with pure hydrogen, thus heating the tube to incandescence and vapourising the metal or salt placed therein. The graphite tubes were from 15 to 20 cm. long, 4 mm. internal diam., and, except at the ends, 0·5 mm. thick in the walls. When metallic sodium was used only visual observations of the spectrum was possible, owing to the very rapid disintegration of the tubes which took place. The D lines did not appear readily, but only as moderately bright lines at the highest temperatures. With NaCl seven pairs of lines were photographed, including the D lines, which appeared readily and with considerable intensity. de Watteville observed the same pairs in his flame spectrum with almost exactly the same intensities. With metallic Ca seven lines were observed but not the H and K lines. These two lines were twice obtained in other cases, when probably a slight trace of Ca was present as impurity. Again, the intensities agree with de Watteville's values. Bands were also observed with heads at λλ5984, 5816, and 5543—a fact which proves that they cannot be due to the oxide or chloride, which is the usually accepted view. A large number of lines were obtained with Fe which agree also very well with de Watteville, considering the differences in experimental conditions. In the case of Cu the only line seen was λ5106, but the bands at λλ4005, 4280, 4499, 4547, 4593, 4649, and 4689 were also obtained. Since these bands have also been observed with the arc furnace and oxyhydrogen flame, it would appear that they must be due to the metal itself and not a carbide or hydride. In the case of Hg no lines were observed, nor was any satisfactory result obtained with Cs, since only the pair at λλ4593, 4555 was seen faintly. Taken as a whole, the results would show that a sufficiently high temperature can produce radiation without the intervention of either electrical or chemical action, and further, that the radiation of the flame spectrum is very largely a thermal effect, aided, no doubt, by the chemical processes taking place. E. C. C. B.

1415. *Spectrum of Radium Emanation.* **E. Rutherford and T. Royds.** (Phil. Mag. 16. pp. 313–317, Aug., 1908. Nature, 78. pp. 220–221, July 9, 1908.) —A photographic measurement of the spectrum lines of radium emanation, containing 34 lines between λ = 5721 and λ = 3622. Three of the lines, λλ = 5721, 5589, and 5393, were measured visually, while the others are probably correct within 0·5 tenth-metre. [See also Abstract No. 1520 (1907).] E. C. C. B.

1416. *Two different Conditions in the Iron Arc.* **H. Buisson and C. Fabry.** (Comptes Rendus, 146. pp. 1143–1145, June 1, 1908.)—The ordinary aspect of the arc between two iron electrodes has been previously described by the authors, and exhibits a single bright point upon each pole from which start the flames of the arc. The two bright points show the spark spectrum, while the flames show the arc spectrum, the negative flame being the brighter of the two. If a high e.m.f. is used (220–440 volts) and the external resistance be increased (the distance between the electrodes being kept constant), a stage is reached at which the appearance of the arc is changed. The two bright points and the positive flame vanish, leaving only the negative flame. The transition from the first to the second condition is not sharply defined, as there is a region of uncertainty when either of the two may appear. The two conditions may be observed with a positive pole of iron and a negative of copper or carbon. [See Abstract No. 918 (1908).] E. C. C. B.

1417. *The Red Portion of the Arc Spectrum of Calcium Chloride.* **C. F. O. Meisenbach.** (Zeitschr. wiss. Phot. 6. pp. 258–270, July, 1908.)—The arc spectrum of $CaCl_2$ was photographed with a large Rowland grating between λ5478 and λ6718, the wave-lengths being determined within 0·001 tenth-metre. Both the line spectrum and band spectrum were observed, and in the case of the latter the four groups conform extremely well to Deslandres' law. E. C. C. B.

1418. *Existence and Modification of Enhanced Lines in the Spectra of Flames at different Temperatures.* **G. A. Hemsalech** and **C. de Watteville.** (Comptes Rendus, 146. pp. 1389–1392, June 29, 1908.)—In a previous paper [Abstract No. 1091 (1908)] the authors have noted the existence of a supplementary spectrum in their flame spectra which shows the spark lines. They now point out that in the case of iron the enhanced lines are well marked in this supplementary spectrum. They are best observed in the case of the air-coal gas flame, their intensity tending to decrease as the temperature of the flame is raised. It is interesting to note that this diminution is more marked in the case of Duffield's polar A lines than in lines which are confined to the neighbourhood of the electrodes of the arc but still have the character of arc lines. [See Abstract No. 1104 (1908).] E. C. C. B.

1419. *Spectrum of the Discharge from a Glowing Lime Kathode in Mercury Vapour.* **F. Horton.** (Cambridge Phil. Soc., Proc. 14. pp. 501–507, July 16, 1908.)—A Pt kathode was used covered with lime and heated by an electric current. A potential between 120 and 400 volts was usually used for the discharge in the vacuum tube. It was found that the spectrum of the discharge showed five new lines at λλ6912, 6715, 6232, 6121, and 6070, which were traced to Hg. The frequency-differences between the first two and the third and last lines are 424 and 428 respectively. E. C. C. B.

1420. *Flame Spectra of Calcium.* **G. A. Hemsalech** and **C. de Watteville.** (Comptes Rendus, 147. pp. 188–190, July 20, 1908.)—A study of the flame spectrum of calcium, produced by the author's well-known method, between the limits $\lambda = 4878$ and $\lambda = 3934$. It is interesting to note the intensity of the H and K lines in relation to the rest, for when air is used in the blast flame they are very faint, but when oxygen is used they are the brightest lines with the exception of the line at $\lambda = 4227$. E. C. C. B.

1421. *The most Sensitive Rays of the Metalloids, Tellurium, Phosphorus, Arsenic, Antimony, Carbon, Silicon, and Boron.* **A. de Gramont.** (Comptes Rendus, 146. pp. 1260–1263, June 15, 1908.)—In a previous paper the author has observed the most sensitive rays of certain metals, *i.e.*, those rays which persist longest in the spark spectrum when the concentration of the metal in the electrodes is steadily decreased [Abstract No. 1844 (1907)]. The present communication deals with one section of the non-metals; elements of the other section comprising F, Cl, Br, I, O, S, Se, and N do not show any differences in the sensitiveness of their spectrum lines. [Errata, p. 1488, June 29, 1908.] E. C. C. B.

1422. *Resolution of Ytterbium into its Constituents.* **C. A. v. Welsbach.** (Akad. Wiss. Wien, Sitz. Ber. 116. 2b. pp. 1425–1469, Nov. and Dec., 1907.)—A full account of the methods employed in the resolution of ytterbium into two new elements. These, to which the author gives the names aldebaranium (Ad) and cassiopeium (Cp), have the atomic weights 172·90 and 174·23 (O = 16) respectively. Detailed measurements of the spark spectra with plates accompany the paper. E. C. C. B.

1423. *Absorption Spectra of some Compounds obtained from Pyridine and Collidine.* **J. E. Purvis.** (Cambridge Phil. Soc., Proc. 14. pp. 435–440, July 16, 1908.)—The absorption spectrum of 3 : 5 dichloropyridine shows that this compound conforms to the type established by the series pyridine, tri-, tetra-, and penta-chloropyridines, namely, that the introduction of chlorine into the pyridine nucleus increases the persistence of the absorption band and shifts the head towards the red. Further, the absorption of collidine in the presence of HCl is modified in the same way as is that of pyridine, namely, by the increased persistence of the band. In the case of collidine and similar compounds with side chains the effect of the side chains is to restrain the motions of the ring to which the band is due, while the introduction of chlorine into the nucleus increases the persistence, so that the two influences are antagonistic. The results of an examination of a 7-chlorolutidine agree with the chemical evidence as to its constitution, namely, that one chlorine atom is attached to the nucleus while the remaining six have substituted the hydrogen atoms of the two methyl groups.
E. C. C. B.

1424. *Dispersion of Magnetic Rotatory Power in the Neighbourhood of Bands of Absorption in the Case of Rare Earths.* **J. Becquerel.** (Phil. Mag. 16. pp. 158–161, July, 1908.)—Remarks on the communications of R. W. Wood and G. J. Elias [Abstracts Nos. 597, 598, 1108 (1908)]. The author points out that all the results hitherto obtained on the dispersion of magnetic rotatory power in the neighbourhood of absorption bands agree with the hypothesis based on the Hall-effect, the rotations being in the same sense on each side of a band and in the opposite sense in the interior of the band. The complex results observed in such cases as the tysonite band ($\lambda = 5770$) are to be accounted for by the fact that the band is not a simple one and that positive as well as negative electrons functionate in producing bands.
E. C. C. B.

1425. *Influence of Temperature and Magnetisation upon Selective Absorption and Fluorescence Spectra.* **H. du Bois** and **G. J. Elias.** (Deutsch. Phys. Gesell., Verh. 10. 12. pp. 429–438, June 30, 1908.)—The elements can be arranged in seven groups in descending order in paramagnetic properties. The present paper deals with four of these groups, viz., oxygen, metals of the iron group, the rare earths, and the uranium group; the behaviour of their absorption bands with temperature-change and in the magnetic field being described. In the case of rubies the fluorescence bands behave just like the absorption bands. [See also Abstract No. 1108 (1908).] E. C. C. B.

1426. *Zeeman-effect in Weak Magnetic Fields.* **O. v. Baeyer.** (Deutsch. Phys. Gesell., Verh. 10. 10. pp. 357–365, May 30, 1908.)—Some observations of the resolution of the line $Hg\lambda = 491\ \mu\mu$ in weak fields of the strengths 751, 2,580 and 6,870 gauss. A Wollaston prism was used to separate the outer from the inner components. The values of $1{\cdot}95 \times 10^7$, $1{\cdot}95 \times 10^7$, and $1{\cdot}98 \times 10^7$ were respectively obtained in the three fields used, and no definite evidence of asymmetry was secured. [See Abstract No. 656 (1907).]
E. C. C. B.

1427. *Emission of Polarised Light by Fluorescent Gases.* **R. W. Wood.** (Phil. Mag. 16. pp. 184–189, July, 1908. Phys. Zeitschr. 9. pp. 590–593, Sept. 15, 1908. Translation.)—Previous attempts to detect polarised light in the emission of fluorescent vapours have yielded negative results. The present paper describes experiments in which as much as 80 per cent. of polarised light was detected in the resonance radiation of sodium and potassium vapour. The apparatus used consisted of a steel tube with a lateral branch brazed to its centre for the observation of the fluorescent light at an angle of 90° with the exciting beam. The metal was contained in a small retort, also brazed to the large tube, immediately below the lateral observation-tube. The light of the arc was focussed by a large lens at the centre of the large tube immediately in front of the lateral branch. A Savart plate was used for the detection. It was found that the polarisation was strongest when the temperature of the tube was comparatively low, *i.e.*, when the fluorescence first appeared. The phenomenon is discussed, and possible explanations suggested. The author also states that the radial polarisation of the solar corona can be satisfactorily explained by regarding the corona as a cloud of mixed metallic vapours fluorescing under the terrific radiation from the sun. A. W.

1428. *Velocity of Röntgen Rays.* **J. Franck** and **R. Pohl.** (Deutsch. Phys. Gesell., Verh. 10. 13. pp. 489–494, July 15, 1908.)—A rejoinder to Marx [Abstract No. 787 (1908)], in which various ingenious modifications of his experiments are made to prove that the effective potential and not the phase-difference is the deciding factor which determines the sign of the charge collected by the electrometer. It is concluded that Marx's results have nothing to do with the velocity of Röntgen rays. **E. Marx.** (Ibid. 10. 16. pp. 597–608, Aug. 30, 1908.) R. S. W.

1429. *Disappearance of Induced Radio-activity.* **E. Sarasin** and **T. Tommasina.** (Comptes Rendus, 146. pp. 1205–1208, June 9, 1908.)—Pursuing their researches on the cause of the double curve of disactivation shown by conductors covered by an insulating layer and rendered radio-active with a positive or negative charge [see Abstract No. 2047 (1907)], the authors describe further experiments which explain the phenomenon. There occur at the same time two effects—that of electric convection and that of ionisation by the radio-active radiation. It seems that the ionisation is not simply a production of positive and negative ions, but that there occurs the formation of conducting molecular chains analogous to chains of filings. The atomic disaggregation of radio-activity furnishes free electric energy, which is transported by, or which transports, the emanation. This latter, on meeting in its diffusion the molecules of the dielectric, brings to them the charges which, polarising them by influence, causes them to adhere, forming thus alignments or conducting bridges. By a modification of their previous arrangements the authors prove the absorption by the dielectrics of the charge which has been given to them during their activation. Confirmation is afforded of the fact that activation and disactivation are much more slow when the charge employed is positive. The absorption and then the auto-emission of the charge are a direct function of the radio-activity. They are the true cause of the doubling of the curve of disactivation. J. J. S.

1430. *Electrons in the Helium Atom.* **H. Erfle.** (Deutsch. Phys. Gesell., Verh. 10. 9. pp. 331–338, May 15, 1908.)—The determination of the ratio e/m for a-rays by Rutherford indicates that they consist of helium atoms deprived of two electrons, and thus possessing a double positive valency. Regener's scintillation experiments [Abstract No. 791 (1908)] are not in disagreement with this view. The author endeavours to determine the number of electrons loosely and quasi-elastically attached to the helium atom from the theory of dispersion, using the figures of Herrmann and of Scheel and Schmidt [Abstracts Nos. 1255, 1256 (1908)]. The former give a probable value 0·253 for the lower limit of the number of electrons per atom participating in its proper vibration, which would have a wave-length of 118 $\mu\mu$. If there is only one ultra-violet proper period, so that the proportion p of electrons to atoms is independent of the wave-length, the above value is not a limiting value, but a real value. It is surprisingly small, but it recalls the small proportion of optically effective electrons found by J. Becquerel in the absorption bands of tysonite. E. E. F.

1431. *Influence of Temperature on Radio-activity.* **W. Engler.** (Ann. d. Physik, 26. 3. pp. 483–520, July 7, 1908. Extract from Dissertation, Freiburg.) —Previous experiments by Bronson and Makower have been contradictory. The author heats the active substance in an electric furnace, and measures the activity before, during, and after heating. It is found that increase of temperature accelerates radio-active change in the case of radium if the activity be measured by the more absorbable rays. After cooling, the disintegration proceeds again at the normal rate. With radium emanation the changes are complicated, and it is inferred that this gas is not a simple one. R. S. W.

1432. *Emission of Electricity from the Radium Active Deposit.* **W. Duane.** (Amer. Journ. Sci. 26. pp. 1–13, July, 1908. Translation.)—The rate of decay of the deposit is measured by the amount of electricity it discharges to a concentric conductor; the usual method is to measure it by the amount of ionisation it produces. The decay curve differs from that usually obtained. This result can be explained if it be supposed that RaB emits a large amount of easily absorbable ionising rays, and the author interprets his results in this sense. By measuring the magnetic deflection, and assuming for e/m the value $1·87 \times 10^7$ the velocity is found to be 4×10^8 cm./sec. R. S. W.

1433. *Secondary β-rays.* **J. A. McClelland.** (Roy. Soc., Proc. Ser. A. 80. pp. 501–515, June 10, 1908.)—Referring to previous papers on this subject, the author first describes the results of tests undertaken to find the fraction of the total secondary rays due to the incident γ-rays. This was determined by using a magnetic field to deflect the incident β-rays. It had previously appeared clear that the secondary effects due to the γ-rays were very small compared with those produced by the β-rays. With the strongest field used the secondary radiation was cut down to about 4 per cent. of its value when the field was off. The results obtained formerly and in the experiments here described may be regarded as applying to secondary rays, more than 99 per cent. of which are β-rays, and of which 96 per cent. are produced by the incident β radium rays. Experiments were made on the intensity of the radiation at different inclinations to the normal and for different angles of incidence. It was found that a portion of the secondary β-rays follows approximately the ordinary law of reflection. This portion does not vary much in amount when the material of the plate exposed to the primary radiation is changed. It is referred to as the "reflected" portion. When the secondary radiation is measured in such a way as to be comparatively free from reflected rays, it depends on the atomic weight of the substance in an even more striking manner than has been hitherto shown. The results of changing the angle of incidence of the radiation are expressed in a series of curves relating to different elements he curve for normal incidence is almost exactly a cosine curve, showing that when the primary rays are normal to the exposed plate the secondary radiation in any direction is proportional to the cosine of the angle between that direction and the normal. This result should follow from the fact that the radiation from an element of volume at a depth in the plate traverses a thickness inversely proportional to the cosine of the angle between its direction and the normal. The results agree in showing that the portion of the secondary radiation called the reflected rays is of greater relative importance the smaller the atomic weight of the substance. This is so, not because the reflected radiation is actually greater for low atomic weights, but because the other portion of the secondary radiation—the true secondary—diminishes rapidly with the atomic weight. Some experiments were made on the absorption of secondary rays. The intensity of the rays was measured before and after passing through an absorbing layer of three sheets of tin-foil. The results indicate that the total secondary radiation may be divided into two parts. When the incident rays are normal, and therefore the reflected part small, the rate of absorption of the secondary rays from different substances is decidedly different, and in all cases is greater than that of the primary rays. When, however, the conditions are favourable for greater reflection, the angles of incidence of primary and emission of secondary being large and equal, the rate of absorption varies much less from one substance to another, and is in all cases not very different from that of the primary rays. Measurements were also undertaken of the total secondary radiation in all directions for different angles of incidence. The total radiations for the four elements tested are given in the following table, in which the numbers are reduced so as to correspond to equal amounts of primary rays at the various angles.

Angle of Incidence of Primary Rays.	Total Secondary Radiation for Equal Amounts of Primary Rays.			
Degrees.	Pb.	Sn.	Cu.	Al.
10	58	38	24	9
30	60	40	28	11
45	61	44	30	15
60	68	57	42	23
75	58	46	46	27
80	56	41	28	17

The general result of the experimental work described is to afford evidence that the secondary β-rays may be regarded as consisting of two parts—the true secondary rays and the "reflected" rays; these two portions differing as regards distribution and character, and probably also in origin. The reflected rays may be regarded as consisting of some of the incident β-particles which in the path they have traversed in the exposed plate have not actually penetrated into, or not caused any change of energy of, any atomic system. The other portion, or true secondary radiation, has been previously discussed, and there is strong evidence that the β-particles composing it are particles expelled from the atoms when disturbed by the entry of the primary rays. J. J. S.

1434. *Radio-activity of Lead.* **J. Elster and H. Geitel.** (Phys. Zeitschr. 9. pp. 289–294, May 1, 1908.)—On continuing their experiments upon the rate of decay of radio-activity of chemically precipitated and of ordinary lead [see Abstract No. 1158 (1907)], and upon the range of the α-rays in air, the authors come to the conclusion that the active preparations which can be obtained from lead owe their radio-activity to long-lived products of the radium series, particularly to RaF. S. G. S.

1435. *Radio-activity in an Electric Field.* **A. S. Eve.** (Phil. Mag. 15. pp. 720–737, June, 1908.)—The author has confirmed the conclusions of S. J. Allen and others with regard to the varying velocities of secondary electrons, and corrects his previous statements on this point. The coefficients of absorption by Al of the incident secondary radiations due to the β- and γ-rays of radium produced from various substances have been determined. The lighter substances emit negative rays not only less in quantity than the dense, but these rays are initially more readily absorbed. Some substances, such as brick, slate, wood, paper, and carbon give rise to penetrating incident secondary rays, originating from a depth of several cm., which are either secondary γ-rays or high-velocity negative rays. After screening, the secondary radiation from brick or paper may exceed that from a heavy substance such as lead. In an electric field with the lines of force parallel to those of direction of motion the velocity of the α-rays can be increased or diminished, and there is apparently a slight variation of range. The same method may be applied to primary β-rays or to secondary rays due to β- and γ-rays. The amount of secondary radiation follows an order depending on the atomic weights of the radiators. It is shown that the velocities regarded as a group, as well as the initial absorptions by Al, follow the same order, so that the main secondary negative rays are projected with velocities which are a function of the density, or the atomic weight, of the radiating substance, the velocities being greater for the more dense. The main group of electrons, therefore, emerge with less velocity from the lighter substances. The square root of the percentage differences of ionisation, due to a reversal of potential of the radiator, is inversely proportional to the secondary radiation from the radiator. The experiments described are preliminary ones, and the electrical method used is similar to that of Lenard when he proved that the kathode rays could be accelerated or retarded in an electric field when the particles moved along the lines of force. A metal plate covered with an active deposit from thorium hydroxide was charged to a potential of ±80,000 volts and placed parallel and opposite to the thin Al face of a gold-leaf electroscope.
J. J. S.

1436. *Heat Developed in Radio-active Thorium Oxide.* **G. B. Pegram** and **H. W. Webb.** (Phys. Rev. 27. pp. 18–26, July, 1908.)—Experiments were made with the object of detecting and measuring the rate at which heat is developed in a mass of thorium oxide on account of its radio-activity. The thorium oxide (not pure, but old Welsbach mantles ground up) was contained in a 5-litre spherical Dewar bulb, suspended in a metal cylinder, which in turn was suspended in an ice-bath. By means of thermo-elements with one set of junctions in the thorium oxide and the other set against the top of the metal cylinder, the temperature-difference between the thorium oxide and the ice-bath was measured. Heat was then produced in the bulb at a known rate by sending a current through wires laid in the thorium oxide, and the temperature-difference determined after a constant value had been reached. As the temperature-differences were very small, they were assumed directly proportional to the rate of heat development; and so from the temperature-differences and the known rate of heat development by the current the rate of heat development by the thorium oxide was estimated. The rate of energy liberation in the material used was found to be 46 per cent. of the rate of energy liberation in thorium oxide with all its disintegration products present in equilibrium amount, for the activity when tested was only 46 per cent. of ThO_2 in its equilibrium or mineral state. The result reached by the authors is that the rate of heat development in old or mineral thorium oxide is $2{\cdot}1 \times 10^{-5}$ gm.-cals. per hour per gm. Radium bromide in its equilibrium state (as far as radium C) liberates heat at 3·2 million times this rate. J. J. S.

1437. *Electrical Charge of the Active Deposit of Actinium.* **S. Russ.** (Phil. Mag. 15. pp. 737–745, June, 1908.)—It has been shown that the active deposit of thorium is almost entirely directed to a negative electrode. In a vessel containing thorium emanation more than 100 times as much active deposit will be obtained on a negative wire as on one charged positively; this ratio is reduced considerably if the pressure in the vessel is lowered to a few mm. In the case of actinium the effects are opposite. The activity of the negative was only twice that of the positive pole at atmospheric pressure, and this ratio was increased to 22 on lowering the pressure to a few mm. It is found that the activity of the negative electrode can be made to vary from twice to more than a hundred times that of the positive without altering the pressure; the variable which determines the electrical charge of the carriers of the active matter being the distance which they travel before reaching the electrode. When this distance is small, the particles are almost completely directed to the negative pole, but when the distance of travel is increased the number reaching the positive pole steadily increases. The experiments described indicate that the collisions of the active deposit-particles with the gas molecules or ions with which they are mixed determine the sign of the electrical charge which they exhibit. J. J. S.

1438. *Condensation of the Actinium and Thorium Emanations.* **S. Kinoshita.** (Phil. Mag. 16. pp. 121–131, July, 1908.)—The determination of the temperatures of condensation and volatilisation of actinium emanation was carried out using the electrical method employed by Rutherford and Soddy for thorium and radium emanations. Thorium emanation was investigated under the same conditions as actinium emanation for the sake of comparison. It was found that the actinium emanation begins to condense at about —120° C., and some of the emanation remains uncondensed below that temperature. At about —150° C. it condenses as a whole. These and the intermediate temperatures at which a certain proportion of the emanation condenses, vary with the pressure, but the variation becomes less when the pressure increases. Experiments on similar lines with thorium emanation show that it condenses at about 2° or 3° C. higher temperature than the actinium emanation, the dependence of their condensation-points upon pressure being very similar. J. J. S.

1439. *Helium and Radio-activity of Minerals.* **R. J. Strutt.** (Roy. Soc., Proc. Ser. A. 80. pp. 572–594, June 20, 1908.)—A large number of rare and common minerals have been examined for their helium and argon content, and the results are given in tables showing the "helium ratio," *i.e.*, the number of c.cm. of helium per gm. of uranium oxide. The gases are extracted by heating the original material; for the methods of purification and manipulation the paper must be referred to. If helium is present in any mineral not containing any of the usual radio-active constituents, it might be looked on as evidence of subatomic changes not accompanied by ionisation. Helium can be detected in almost all minerals. The quantity is in most cases about what would be anticipated from the traces of uranium and radium which the minerals contain. Where much higher helium ratios are found, the excess of the gas can always be connected with the presence of thorium except in one case. Thus the experiments afford no evidence in favour of helium production by radio-activity of ordinary elements. The outstanding case is beryl, which contains abundance of helium, without anything approaching a sufficient radio-activity to explain its presence. Igneous rocks, and probably siliceous minerals generally, contain small quantities of argon. There is no indication that it increases with the amount of radio-active material. R. S. W.

1440. *Radio-activity of a Smoke-laden Atmosphere.* **S. J. Allen.** (Phys. Rev. 26. pp. 483–496, June, 1908.)—The author has measured the rate of decay of the radio-activity induced on a wire exposed in the smoke-laden atmosphere of Cincinnati, and charged positively, negatively, or not at all, the atmospheric conditions varying from a clear, dry, cold day, to a warm, moist and smoky one. The rate of decay shows considerable variation, but activity due to radium is always present, and that of thorium occasionally. Fifty-two determinations were made, which may be arranged in three well-defined groups: (1) Those in which the radio-activity appears to be due to a mixture of RaB and RaC in invariable proportions; (2) those in which it is probably caused by RaC; and (3) those which, while similar to the others, have also some activity due to ThA. The radio-activity can to a large extent be collected on an uncharged wire, being carried there by the settling of smoke particles. W. H. St.

REFERENCES.

1441. *Quadruple Slit for Spectroscopes.* **M. Rinck.** (Zeitschr. Instrumentenk. 28. pp. 169–171, June, 1908.)

1442. *Theory of the Prismatic Telescope Objective.* **H. Harting.** (Zeitschr. Instrumentenk. 28. pp. 165–168, June, 1908.)

1443. *Dispersion of Long Waves by Rock-salt and Sylvin.* **H. Rubens.** (Ann. d. Physik, 26. 3. pp. 615–621, July 7, 1908.)—A criticism of Paschen's work [see Abstract No. 1081 (1908)] with correction of his values for rock-salt as obtained from the Ketteler-Helmholtz dispersion formula. As thus corrected the values of both investigators are in good agreement to the fourth decimal, Paschen's work thus confirming the older values of Rubens, Nichols, and Trowbridge which do not quite attain the accuracy of Paschen's measurements, but are carried farther into the long-wave region of the spectrum. G. E. A.

1444. *Luminous Properties of Conducting Helium.* **P. G. Nutting.** (Bureau of Standards, Bull. 4. pp. 511–523, May, 1908.)—The full paper corresponding to Abstract No. 661 (1908).

1445. *Nature of γ-Rays.* **W. H. Bragg** and **J. P. V. Madsen.** (Phil. Mag. 15. pp. 663–675, May, 1908. Paper read before the Physical Soc., April 10, 1908. Chem. News, 97. pp. 162–165, April 3, 1908. From Trans. of the Royal Society of South Australia, 32. 1908.)—The full paper containing the experimental evidence on which Bragg bases his electrical-doublet theory of the γ- and Röntgen-rays. The chief results have already been given [see Abstracts Nos. 1826 (1907) and 412 (1908)]. R. S. W.

HEAT.

1446. *Specific Heats of Liquids.* **T. W. Richards** and **A. W. Rowe.** (Amer. Acad., Proc. 43. No. 18. pp. 475–488, June, 1908. Contribution from the Chem. Lab. of Harvard College.)—An account is given of a new method for the accurate determination of the specific heats of liquids, using the adiabatic calorimeter and a chemical source of heat. The substance to be studied is placed in a calorimeter surrounded on all sides by a jacket whose temperature can be changed to correspond exactly with the warming of the substance by some known source of heat. In order to raise the temperature of the substance within the calorimeter the heat of neutralisation of pure sulphuric acid and sodic hydroxide was used; this has the advantage of being not very changeable with the temperature. Definite amounts of acid and alkali were allowed to react in a Pt flask surrounded by the liquid in the calorimeter, and the rise of temperature in the whole system was carefully noted. By comparing the rise of temperature under these conditions with the rise shown when pure water is in the calorimeter a comparative measurement of the heat capacity of the liquid is made. The method was applied to measure the heat capacity of a solution of hydrochloric acid of concentration $HCl + 200H_2O$. The mean value was found to be 0·9809, with a maximum variation from the mean of 0·08 per cent. The method was also used in the accurate determination of heats of dilution. A solution of alkali was used whose heat of dilution automatically compensates for any excess which might have been added. J. J. S.

1447. *Ratio of the Specific Heats of Gaseous Mixtures.* **V. I. Kotovič.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. 1. pp. 16–19, 1908.)—The author deduces an expression for the ratio of the two specific heats of a gaseous mixture. By means of this expression he shows that the relation of the velocity of sound in dry air, V_0, to that in moist air, V, is given by the equation—

$$V_0 = V\sqrt{\frac{[p_1(\gamma_2-1)+p_2(\gamma_1-1)]\gamma_1(p_1+\delta p_2)}{[p_1\gamma_1(\gamma_2-1)+p_2\gamma_2(\gamma_1-1)]P}},$$

where γ_1 and γ_2 are the ratios of the two specific heats for dry air and moist air respectively, p_1 and p_2 the corresponding pressures, P the total pressure, and δ the density of water vapour compared with that of air. T. H. P.

1448. *Effect of Mechanical Vibration upon CO_2 near the Critical Point.* II. **W. P. Bradley, A. W. Browne,** and **C. F. Hale.** (Phys. Rev. 26. pp. 470–482, June, 1908. Contribution from the Cryogenic Lab. of Wesleyan Univ.)—A further investigation of the conditions favouring formation of fog by CO_2 near its critical point [see Abstract No. 148 (1905)]. The authors differentiate between *dynamic* and *residual* fog, the former, which clears up at once when the vibrations are interrupted, consisting of droplets or bubbles that are more numerous, and in part larger, than those of residual fog, which remains for a time after vibration has ceased. The sensitiveness of the CO_2 to vibrations depends on (i.) relative volume of pressure jacket, (ii.) thickness of its walls, (iii.) internal diam. of pressure tube, (iv.) temperature, (v.) location of the meniscus, and (vi.) vertical distance from the meniscus. Specially pure CO_2 was used in the experiments, containing only 0·02 to 0·0025 per cent. unabsorbed by KOH, and having a mean critical temperature of 81·26° C. (cor.). W. H. St.

1449. *Regions of Maximum Ionisation in the Fog-chamber.* **C. Barus.** (Science, 28. pp. 26–28, July 3, 1908.)—Radium was introduced into a cylindrical fog-chamber by means of an Al tube thrust axially from one end to the other of the horizontal chamber. The radium was placed in various positions inside, and observation showed that the maximum nucleation occurred where there was no radium. The occurrence of maxima and minima of nucleation seems connected with the presence of the γ-rays, since covering the Al tube with a thick lead pipe caused the phenomenon to be slightly reduced in magnitude but not in character. J. J. S.

1450. *Nuclei Produced in Gases by Sudden Cooling.* **G. Owen and A. L. Hughes.** (Phil. Mag. 15. pp. 746–761, June, 1908.)—A continuation of experiments previously described [see Abstract No. 1866 (1907)]. By a modification of the apparatus the cooling was made to take place more rapidly, and it has been found that the more sudden the cooling the higher is the nucleating temperature (*i.e.*, the temperature below which the gas has to be cooled before nuclei appear) and the larger is the number of nuclei produced at any given temperature. Experiments were carried out in the case of air and in various pure gases—CO_2, ethylene, and methane. With ethylene no nucleating temperature was found; nuclei were not produced before the gas was condensed. The effect in mixtures was also investigated. The effects in pure air and air mixed with 5 per cent. of CO_2 were indistinguishable. Keeping the nuclei at a high temperature aids their disappearance, but if a sufficiently long time be allowed the nuclei disappear even at the temperature of production. The formation of molecular aggregations is, as before, given as the general explanation of the results obtained. The nuclei are not due to dust particles, to impurities in the gases, or to insufficient drying. Wet gases and those carefully dried behave in much the same way. J. J. S.

1451. *Discontinuity of Temperature at the Limiting Surface of Two Bodies.* **O. D. Chvolison [Chwolson].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. 1. pp. 1–4, 1908.)—The author first discusses the work of Schaufelberger [Abstract No. 1822 (1902)], Smoluchowski (Phil. Mag. 46. p. 192, 1898), and Warburg and Gehrcke [Abstract No. 1660 (1900)] on the difference of temperature between the surface of a solid body and the layer of gas in contact with the surface, the solid and gas having different mean temperatures. The marked temperature-differences observed in such cases are due to the wide variation of the mean path of the gaseous molecules from that of the molecules of the solid. Where two contiguous solids are at different temperatures the case is different. If s represents the common surface, k_1 and k_2 the heat conductivities, and t_1 and t_2 the temperatures of the bodies, n the direction of the normal to s, ϕ and ψ the angles between the isotherms and the normal n in the two bodies, then for the same surface $t_1 = t_2$, $k_1 dt_1/dn = k_2 dt_2/dn$, and $dt_1/ds = dt_2/ds$. Hence $\tan\phi/\tan\psi = k_2/k_1$. If a final discontinuity of temperature exists, its magnitude, $t_2 - t_1$, will be a function of the intensity of the flow of heat, and as this intensity will generally be different at different points of s, $t_2 - t_1$ will also vary along the surface. Hence dt_1/ds and dt_2/ds become unequal, and the equation $\tan\phi/\tan\psi = k_2/k_1$ ceases to be true.

T. H. P.

1452. *Discontinuity of Temperature at the Boundary of Two Liquids.* **L. Kolovrat-Červinskij.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. 1. pp. 5–14, 1908.)—The author describes his investigations on the distribution of temperature in a vertical column consisting of two immiscible liquids, the two extremities of the column being maintained at different temperatures [compare preceding Abstract]; the temperatures were measured thermo-electrically. The curves connecting temperature with distance from the surface of separation for water and vaseline oil show that a layer of oil about 1 mm. in thickness contiguous to the water has a lower heat-conductivity than the remainder of the oil, and possibly consists of some kind of emulsion. Neglecting this layer, it would seem that a temperature-difference of about 2° exists between the oil and water at their surface of contact. Similar experiments with mercury and superposed water show that, in this case, no such difference of temperature exists of greater magnitude than the experimental error, which amounts to about 0·15°. From the results approximately accurate values are deduced for the relation of the conductivity of mercury to that of water and for the temperature-coefficient of the conductivity of water.

T. H. P.

1453. *Jeans-Lorentz Radiation Formula.* **O. Lummer** and **E. Pringsheim.** (Phys. Zeitschr. 9. pp. 449–450, July 15, 1908. Physikal. Inst. d. Univ., Breslau, May, 1908.)—Lorentz has given a new deduction of a formula which Jeans had obtained for the Kirchhoff radiation function [see Abstract No. 1459 (1908)]. This formula is of the form $F(\lambda,T) = \text{const.} \times T \times \lambda^{-4}$ where λ is the wave-length, T the absolute temperature, and $F(\lambda,T)$ the emissivity of a black body for the wave-length λ and temperature T. According to this formula the energy-curve shows no maximum. It is, moreover, opposed to the Stefan-Boltzmann law, to Wien's displacement law, and to Planck's radiation equation. The authors give reasons why the formula cannot be accepted; they also criticise the theory given by Lorentz. **H. A. Lorentz.** (Ibid. pp. 562–563, Sept. 1). Lorentz admits that Lummer and Pringsheim are right in their criticism.

A. W.

1454. *Dynamical Analogues of Temperature Equilibrium.* **G. H. Bryan.** (Phil. Mag. 15. pp. 765–767, June, 1908. Paper read before the Physical Soc., March 13, 1908.)—The author's method of studying problems dealing with the partition of energy in systems of particles, in which some kind of *statistical* equilibrium exists, is to write down expressions for the second differential coefficients with respect to the time, of the squares and products of velocities or momenta of the system considered. This method appears to have been first used by Burbury. Considering an ideal medium and making the assumption that the field produced by the other particles is independent of the motion of the particle under consideration, the author writes the equation of the energy of a particle of mass m in the form—

$$\frac{d^2}{dt^2}\left(\frac{1}{2}mu^2\right) = \frac{1}{m}\left(\frac{dV}{dx}\right)^2 - u\frac{d^2V}{dtdx} - u^2\frac{d^2V}{dx^2} - uv\frac{d^2V}{dxdy} - uw\frac{d^2V}{dxdz},$$

where u, v, and w stand for the velocity components and V for the potential of the field due to other particles. The assumption that the field produced by the other particles has on an average no directional properties shows that the mean values of the last two terms vanish, and the assumption that a stationary state exists requires that the mean value of $ud^2V/dtdx$ should also vanish. Hence—

$$\left\{\frac{d^2}{dt^2}\left(\frac{1}{2}mu^2\right)\right\}=\frac{1}{m}\left\{\left(\frac{dV}{dx}\right)^2\right\}-[u^2]\left\{\frac{d^2V}{dx^2}\right\},$$

where the brackets denote mean values. For the Newtonian law of force $\Delta V=0$. In this case the mean value of $[d^2V/dx^2]$ also vanishes, and thus the energy acceleration equation takes the form—

$$\left\{\frac{d^2}{dt^2}\left(\frac{1}{2}mu^2\right)\right\}=\frac{1}{m}\left\{\left(\frac{dV}{dx}\right)^2\right\}.$$

The only kind of statistical equilibrium, therefore, is the statical state of unstable equilibrium defined by $dV/dx=0$, $dV/dy=0$, and $dV/dz=0$ on each particle. In the absence of this state an acceleration of kinetic energy will take place. It is thus impossible with the Newtonian law to build up a medium of material particles, either attracting or repelling one another, and possessing properties of energy equilibrium analogous to those of a system of gas molecules. This, however, does not preclude the possibility, under the Newtonian law, of stationary motions such as those occurring in the solar system. Exactly the same conclusions hold good if the law of force is such as to make ΔV negative. The necessary condition, ΔV greater than zero, becomes, for the particular case in which the field is due to an attracting particle placed at the origin, $(1/r^2)d/dr(r^2dV/dr)>0$, which shows that r^2dV/dr increases with r. In other words, the force, if repulsive, must vary according to a higher power of the inverse distance than the square. It is pointed out that the inverse fifth power represents a possible law of force. Whether it is possible to construct a dynamical model whose energy-partition is analogous to Stefan's law is a question for future investigation. A. R.

1455. *On the Canonical Equation of Equilibrium in Monatomic Gases.* **M. Planck.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 32. pp. 633–647, 1908.)—Of all the functions which may be chosen to determine the thermodynamic state of a system—namely, the pressure, volume, and temperature, the entropy S, the free energy F, and the total energy E—the writer gives his reasons for choosing as independent variables, S and V. S he calls the characteristic function. A state of thermodynamic equilibrium is characterised by S being maximum. The canonical equation has the advantage that, using Boltzmann's definition of entropy as depending on probability, it is not necessary to begin with assumptions concerning the law of distribution of velocities or the relation between kinetic energy and temperature. To begin with, the assumption that temperature is proportional to the mean kinetic energy, leads to difficulties, as the author explains. But both this law and the distribution of velocities are consequences of S being maximum coupled with the other assumptions made by the writer. Boltzmann's definition of entropy is as follows: If the volume occupied by the gas be divided into cells each $dxdydz=\tau$, and the limits of the velocities of an atom be $d\xi d\eta d\zeta=\sigma$, then the number of atoms which are in τ and whose velocities are in σ is $f(xyz\xi\eta\zeta)\sigma.\tau$, and the whole number of atoms is $\Sigma_\tau\Sigma_\sigma f.\tau.\sigma.=N$. Then $S=k\log W+\text{constant}$, where k is a certain numerical constant, and W the probability of the given state. W consists of the sum of the numbers of permutations possible for the atoms in the several cells with the velocities attributed to them by the function f. It is assumed that what goes on in any part of space in relation to these atoms is wholly independent of what goes on in any other part—that is, $W = nw$, w being the chance that $r \,.\, \Sigma f \,.\, \sigma$. atoms, *i.e.*, ν atoms, should have the velocities attributed to them in the expression f. So finally $S = k \log n + k \log w +$ constant. Next he considers the potential energy. The energy of any two atoms in given position is the work done against the mutual forces in bringing them to that position from any position in which the potential is zero. The kinetic energy is $\frac{1}{2}\Sigma m(\xi^2 + \eta^2 + \zeta^2)$. Except for these supposed forces, it is in effect assumed that the distribution of the velocities amongst the atoms is wholly independent of their positions in space, and *vice versâ*. From which assumption follows the usual necessary consequence that the velocities are distributed according to Maxwell's law. We owe to Planck a new method of obtaining the old result—namely, as a consequence of S being maximum. He considers specially the case of the atoms being elastic spheres, which was assumed by van der Waals. Planck gives the equation $p = -\frac{kT}{\beta} \log \left(1 - \frac{\beta}{v}\right) - \frac{a}{v^2}$; van der Waals gives $p = \frac{kT}{v - b} - \frac{a}{v^2}$. S. H. B.

1456. *Brownian Motions.* **V. Henri.** (Comptes Rendus, 146. pp. 1024–1026, May 18, 1908.)—The movements of the particles of a rubber emulsion were recorded by means of the micro-kinematograph. The trajectory of each grain is very complex, and shows abrupt changes of direction. Taken over 0·05 sec., the displacement of one grain varies little from that of the others. It ranges from 0·5 to 0·7 μ. Einstein's theoretical formula gives a value four times smaller. The author doubts whether Stokes's law applies to particles of diameters approaching 1 μ. E. E. F.

1457. *Dependence of Brownian Molecular Movement on Temperature.* **M. Seddig.** (Phys. Zeitschr. 9. pp. 465–468, July 15, 1908. Communication from the Physikal. Inst. d. Univ., Marburg.)—It has been shown by Einstein [Abstract No. 1909 (1905)] from theoretical considerations that for a definite interval of time, under otherwise constant conditions, the distance passed over by a particle is proportional to $\sqrt{(T/k)}$, where T is the absolute temperature and k the coefficient of viscosity of the liquid. The author has now determined experimentally, by a photographic method in conjunction with the ultramicroscope, the velocity of movement at different temperatures, and finds values about 6 per cent. greater than the theoretical. This is explained by absorption of heat by the suspended particles and the giving out of this heat again to the surrounding liquid, which is therefore at a slightly higher temperature than that measured by a thermometer in the liquid. A. F.

REFERENCES.

1458. *Coefficient of Linear Expansion at Low Temperatures.* **H. G. Dorsey.** (Phys. Rev. 27. pp. 1–10, July, 1908.)—An account is given of further measurements of the expansion of various substances—gold, lead, zinc, selenium, quartz, rubber, and fibres of compressed paper. [See Abstract No. 1868 (1907).] J. J. S.

1459. *Partition of Energy between ponderable Matter and the Ether.* **H. A. Lorentz.** (N. Cimento, 16. pp. 5–34, July–Aug., 1908. Paper read at 4th Internat. Mathematical Congress, Rome.) [See Abstract No. 1453 (1908).]

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1460. *Mechanical Explanations of Electricity.* **H. Witte.** (Ann. d. Physik, 26. 2. pp. 235–311, June 9, 1908.)—Analyses the various attempts to reduce electromagnetism to mechanical principles. The author classifies the various actual and possible mechanical theories according to their fundamental principles, and groups them in nine classes as follows :—

A.—Action at a distance : Class 1. Instantaneous action. Class 2. Gradual action. B.—Field Action : Class 3. (*a*) Emission ; (*b*) Undulation. Class 4. Neither magnetic nor electric energy kinetic. Class 5. One of the energies kinetic. Class 6. Both energies kinetic. Class 7. One of the energies partly kinetic, the other not kinetic. Class 8. Both energies partly kinetic. Class 9. One of the energies partly, the other wholly kinetic.

The author shows that some kind of ether is essential to any mechanical explanation of electricity, and this ether cannot be incompressible. Five out of the classes—4 to 9—are incompatible with the assumption of a continuous ether, and only class 7 offers some chance of a solution, which may take a variety of forms, and these the author passes in review. But a continuous ether cannot be explained mechanically, and so we must again fall back upon a discontinuous ether, which is not indicated by any physical phenomena. The author finally renounces the possibility of a mechanical theory of electrical phenomena, and points out the desirability of formulating an electric theory of mechanical phenomena. The two rival solutions he describes as "materialism" and "electricism" respectively. E. E. F.

1461. *Atmospheric Electric Potential and Earth-air Current.* **C. T. R. Wilson.** (Roy. Soc., Proc. Ser. A. 80. pp. 537–547, June 20, 1908.)—In previous papers the author has described a method of measuring the charge upon and current through a conductor exposed to the earth's electrical field and maintained at zero potential [see Abstract No. 91 (1907)]. The present paper contains an account of a series of such measurements, taken primarily with the object of testing the method, and, in particular, of gaining some evidence as to whether it is legitimate to deduce from the "dissipation factor," found for the exposed "test-plate" of the apparatus, the current from the atmosphere into each cm.^{2} of the ground when the potential gradient is known. The observations were carried out about 25 miles south of Edinburgh. From Sept., 1906, till April, 1907, inclusive, the place of observation was on a nearly level field in the bottom of a valley about a mile wide and about 700 ft. above sea-level. The later measurements were taken a few hundred yards to the south of this point, just within the mouth of a smaller tributary valley, also flat-bottomed and with short turf. The apparatus used only differed in dimensions and in minor details from that previously described, and the method of use was similar. The dissipation factor is expressed as the percentage of the charge on an earth-connected exposed body which is neutralised per min. The results obtained for the dissipation from the test-plate and from a cylindrical metal cylinder resting on the test-plate show that there is no indication of any marked difference in the dissipation factors.

Comparative measurements of the dissipation, made alternately with the ordinary test-plate of the instrument and with a piece of turf, placed in a shallow tin-plate tray, resting on the test-plate and completely covering it, gave practically the same mean value for the dissipation from both. The agreement is sufficiently good to afford strong grounds for assuming a definite dissipation factor depending on the condition of the atmosphere. By means of a large test-plate close to the ground the factor by which the charge on the exposed earth-connected test-plate has to be multiplied to give the charge per $cm.^2$ of the ground in the immediate neighbourhood was determined. The same factor serves to deduce the current per $cm.^2$ of the ground from that through the test-plate, which is directly observed. The results obtained in this manner are tabulated, and may be divided into three groups, according to the type of weather on the different days. (1) On calm days, with a practically cloudless sky and bright sunshine, with a certain amount of haze, the dissipation factor was least (mean = 6·6 per cent. per min.). (2) With many cumulus clouds about and very clear atmosphere the factor was greatest (mean = 11·2 per cent. per min.). (3) With sky overcast the dissipation factor had intermediate values (mean = 8·05 per cent. per min.). It is remarkable how nearly the mean value found for the current per $cm.^2$ of the ground ($2{\cdot}2 \times 10^{-16}$ amp.) agrees with that deduced by Gerdien ($2{\cdot}4 \times 10^{-16}$ amp.) from the results of measurements of conductivity and potential gradient. The agreement is no doubt to some extent accidental; a systematic series of regular observations would be required before a trustworthy mean value of the current could be obtained. A. W.

DISCHARGE AND OSCILLATIONS.

1462. *Kathode and Canal Rays.* **J. Kunz.** (Phil. Mag. 16. pp. 161–188, July, 1908.)—Describes a series of experiments undertaken with the view of determining the nature of the kathode and canal rays from hollow electrodes. The following conclusions are drawn from the experiments: (1) If a kathode is composed of two circular plates, from any point of the circumference of the free space between the plates we get kathode rays as well as positive rays. The blue kathode rays reach a maximum of luminosity before the red positive rays as the tube is exhausted. As the positive rays pass through a field of negative electrification, they are neutral to a large extent and not much liable to magnetic deflection. (2) If two triangular plates are connected by metal blocks so that the only free space between the plates is in the form of three narrow rectangular ducts crossing one another, it would be expected that the six holes would behave in the same way at a certain comparatively high pressure—that is to say, they should emit bright blue beams corresponding to those observed in the case of perforated cylindrical and spherical kathodes. As the air gets exhausted, the visible kathode rays from the openings at the middle of the sides will still be bright, whereas the rays from the corners become nearly invisible. At a still lower pressure the difference in luminosity becomes smaller. Invisible kathode rays start from all the six holes, probably accompanied by a weak stream of positive ions and neutral molecules. The difference of appearance in the previous stage is due to the fact that the negative glow before the sides of the triangle is very much stronger than before the corners, a phenomenon observed without exception in every case of kathodes having sharp corners. As there is no large open side from which the positive particles may be collected into a sharp beam, we cannot expect to find a distinct beam of canal rays. Experiment has perfectly justified this inference from the theory. (8) If the kathode is made of two parallel square plates separated 8 mm. from one another and connected by thin pins, we should expect to find at a comparatively high pressure four blue broad bands starting perpendicularly from either side of the square. These rays will disappear with decreasing pressure, and will be replaced by red beams accompanied by kathode rays, invisible in air and hydrogen, but producing bright spots of phosphorescence. This expectation is satisfied by an experiment made first by E. Goldstein, who also found that the canal rays passing between the two plates mark their paths by a system of curves drawn on the inner surface of the plates. The positive red rays were found to be very bright and sharp in hydrogen. They are not deflected by a magnetic field of moderate strength. If the electromagnet is placed near to the point where the red rays cut the glass wall, the kathode rays will be collected into a sharp blue beam turning, by a suitable motion of the electromagnet, round the surface of a cone whose vertex lies in the red beam. For experimental details and theoretical discussion of the phenomena observed the original paper should be consulted. A. W.

1463. *The Nature of Charges of Positive Electricity and the Existence of Positive Electrons.* **J. Becquerel.** (Comptes Rendus, 146. pp. 1308–1314, June 22, 1908. Electrician, 61. p. 525, July 17, 1908. Translation.)—By studying the influence of a magnet upon the discharges in a vacuum tube in which the anode and kathode were mounted in separate portions joined by a narrow tube, the author has noted the existence of positive electrons. These electrons must be quite comparable to the ordinary negative electrons and possess a value of *e*/*m* of the same order of magnitude. (Ibid. 147. pp. 121–124, July 13, 1908.)—An amplification of the above paper, containing account of experiments from which the existence of positive electrons is deduced. The view is put forward that the positive and negative electrons combine together and that possibly hydrogen is produced. E. C. C. B.

1464. *Potential Measurements with Glowing Oxide Kathodes.* **W. Westphal.** (Deutsch. Phys. Gesell., Verh. 10. 11. pp. 401–405, June 15, 1908. Physikal. Inst. d. Univ., Berlin.)—Measurements were made of the potential in the Crookes dark space at the kathode in a vacuum tube during the glow discharge by means of a Pt-wire sound. The following are the observations recorded :—

I. FEEBLY RED GLOWING KATHODE.

Distance from kathode...	1	2	3	4	5	6	mm.
Potential	536	816	1,014	1,206	1,352	1,485	volts
Distance from kathode...	7	8	9	15	16	17	mm.
Potential	1,558	1,653	1,706	1,997	2,020	2,040	volts

II. STRONGLY GLOWING KATHODE.

Distance from kathode ...	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	mm.
Potential	42	43	48	55	58	67	75	81	volts
Distance from kathode ...	0·9	1	2	3	4	5	6	—	mm.
Potential	88	95	111	113	116	118	119	—	volts

The measurements confirm J. J. Thomson's theory that the peculiarities of the Crookes dark space with ordinary kathodes are to be explained by an impoverishment in electrons. J. J. S.

1465. *Influence of Humidity on the Electrical Discharge from Points.* **J. Zeleny.** (Phys. Rev. 26. pp. 448–458, June, 1908.)—In order that the author's previous results [Abstract No. 118 (1908)] may be of use under different hygrometric conditions, the effect of water-vapour on the starting potential and on the current with a given potential is investigated. The apparatus is the same as previously used. The changes produced by the water-vapour are related to the absolute water-content of the air and not to its relative humidity. The moistness of the air has little effect upon the potential required to start the discharge, but the potential required to produce a given current increases with the humidity. The curves given enable results obtained with one humidity to be reduced to another. With the point negative the results are more regular as the humidity increases; the results generally are more greatly affected in this case than when the point is positive. R. S. W.

1466. *Changes in Pressure accompanying Point Discharge through Hydrogen containing Oxygen and Nitrogen.* **A. P. Chattock** and **A. M. Tyndall.** (Phil. Mag. 16. pp. 24–47, July, 1908.)—The experiments form part of an attempt to measure the molecular complexity of the ions in point discharge. The plan was to discharge through pure hydrogen against a Pt or Pd plate in the hope that these substances might hold the ions long enough for a measurement of the resulting pressure-change to be made. The number N of complete molecules removed from the gas when the charge on one monovalent ion is passed through is calculated from the contraction in volume, and this is found to vary enormously with the purity of the hydrogen. The paper is chiefly concerned with the effects of these impurities. In all cases where the contraction is due to the combination of H and O it is known that the negative discharge from a point produces the greatest effect, and that the contraction ceases if the discharge is repeated frequently. In the present experiments there is a residual contraction which tends to become the same for discharges of either sign; this is apparently the effect looked for, and the corresponding value of N is 1·1. The contraction is roughly proportional to the amount of electricity that has passed. The methods of deducing the results from the observations are difficult to give in an abstract, but the chief conclusions may be given. Oxygen present in hydrogen at atmospheric pressure and subjected to point discharge combines with hydrogen at the rate of 16 mols. of O per ion for positive and 25 for negative between percentages 2 and 14 by volume. Below 2 per cent. the combination for negative rises rapidly; below 0·2 per cent. the combination for positive is constant and roughly is equal to + 10 mols. per ion. The presence of one part of O in 10 million of H can be detected, and 90 per cent. of the O can be made to combine by point discharge. There is evidence to show that the addition of O above 0·01 per cent. increases the size of the negative ions, while its effect on the positive ions is inappreciable. R. S. W.

1467. *Sparking Potential with very Short Spark-lengths.* **R. F. Earhart.** (Phil. Mag. 16. pp. 48–59, July, 1908.)—Various observers have shown that the least potential required to produce a spark in air is about 350 volts except when the electrodes are very close together. For distances apart of the electrodes less than 3 wave-lengths of sodium light a discharge may take place at lower potentials [Abstract No. 514 (1901)]. The question of interest is, what is the carrier of the discharge in the latter case? if the negative corpuscle, then the nature of the negative electrode will determine when discharge occurs; if the positive metal ion, the positive electrode will have the chief influence. If either one could be the carrier, then the sparking potential will be determined by the electrode having the lower sparking voltage irrespective of its polarity. The third alternative is found to agree with the experimental facts. The least ionising potential for point and plane is 888 volts, *i.e.*, 12 volts less than for plane surfaces. The critical distance is greater for a point and plane than for flat electrodes, and the critical potential is less for a negatively than for a positively electrified point. R. S. W.

1468. *Electric Arc between a Solid and Liquid Electrode.* **G. Athanasiadis.** (Comptes Rendus, 147. pp. 804–807, Aug. 8, 1908. Electrician, 61. p. 873, Sept. 18, 1908. Translation.)—The author records experiments undertaken to find under what conditions an arc can be maintained between a solid and a liquid electrode [see also Abstract No. 2670 (1904)]. When the p.d. was 220 volts and the anode was a thin wire, about 1 mm. in diam., immersed to a depth of 5 cm. in acidulated water, the current attained a max. value of 6 amps. as the resistance in the circuit was diminished. It then fell suddenly to 0·5 amp., the electrode being polarised. The extremity of the wire became phosphorescent, and there was a hissing noise. When, however, the wire was the kathode it became incandescent and melted rapidly owing to the formation of an arc. The same phenomena were noticed when the wires were of Fe, Sn, Al, &c. On reversing the current a second time an arc ensues between the immersed wire and the liquid, and it ultimately melts. If a condenser of 10 mfd. capacity shunt the arc, it becomes more brilliant and the sound becomes shriller, the alternating current in the condenser circuit varying between 0·2 and 0·85 amp. If the main current work a Ruhmkorff coil, powerful sparks are produced, the arc acting to a certain extent like a Wehnelt interrupter the frequency of the interruptions lying between 50 and 180 per sec. The author concludes that Duddell currents are produced when one of the electrodes of the arc is solid and the other liquid. The arc formed between an electrolyte and a solid electrode as kathode can be produced at 220 volts even when the solid electrode is immersed to a depth of 7 cm. This arc acts like a Wehnelt interrupter. It is impossible to produce an arc between a solid anode and an electrolyte as kathode when the voltage is not greater than 220 volts. But we can always obtain the polarisation of the solid electrode. A. R.

1469. *The "Brushing" of Condensers.* **W. Eickhoff.** (Phys. Zeitschr. 9. pp. 405–408, June 15, 1908.)—In reply to Benischke's criticism [Abstract No. 450 (1908)] the author describes experiments with a Leyden jar inverted and having its edges under oil so that no leakage path is provided. With this arrangement "brushing" is found, nevertheless, to occur. The second suggestion of Benischke, that asymmetric resonance curves would also be obtained by using a vacuum tube in parallel with a condenser, is negatived by the results of other experiments detailed. L. H. W.

1470. *Alternate-current Arc as Frequency Converter.* **W. Peukert.** (Elektrotechn. Zeitschr. 29. pp. 562–564, June 4, 1908. Lumière Électr. 3. pp. 145–146, Aug. 1, 1908. Abstract.)—Experiments with an arc between solid carbons, supplied at 200 volts and 50 ∿. The frequency of the oscillations in the shunt circuit (C = 8·4 mfd. and L = 0·00106 henry) was measured by the author's weighing method [Abstract No. 1781 (1906)], which gave a value 1,854 per sec. as compared with 1,900 obtained by using the Thomson formula. The frequency also depends on the current through the arc, but the chief advantage is, according to the author, that the arc is more stable than with direct current. With the capacity reduced to very small values a frequency of order 10^6 was obtained. The arc in this case should not be longer than a few tenths of a mm., and the current not over 2 amps.; the high-frequency current reaches 80 amps. To increase the available energy several arcs may be put in series—ten, for instance; whilst if the arc is placed in hydrogen or coal-gas the energy obtainable is raised still further. Experiments have also been made with such an arrangement, supplied at 3,000 volts, 50 ∿, by means of an oil transformer, and photographs are given of the discharges obtained. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1471. *Dielectric Constant of Helium.* **E. Hochheim.** (Deutsch. Phys. Gesell., Verh. 10. 12. pp. 446–448, June 30, 1908. Physikal. Inst. d. Univ., Marburg, June, 1908.)—Describes a determination of the dielectric constant of helium. The method employed was the electrostatic null-method of Hopkinson-Lebedew. The value obtained for the constant (D) is 1·000074 ± 0·000004 when reduced to normal conditions of temperature and pressure. This result, by comparison with the values of the refractive index of helium—$n^2 = 1{\cdot}0000842$ (Rayleigh), $n^2 = 1{\cdot}0000724$ (Ramsay-Travers), $n^2_{\infty} = 1{\cdot}0000662$ (Scheel-Schmidt)—indicates that Maxwell's relation $D = n^2$ is true for the monatomic gas helium. A. W.

1472. *Selenium Vapour in the Preparation of Light-sensitive Cells.* **W. S. Gripenberg.** (Phys. Zeitschr. 9. p. 519, Aug. 1, 1908.)—Two long furrows or depressions are etched, on a glass plate, at a small distance apart, and filled with platinum. The plate is then exposed to selenium vapour, care being taken not to let the plate become too hot. It is also recommended to carry out the sublimation in a dry CO_2 atmosphere. According to Marc the addition of silver increases the light-sensitiveness. The cell can easily be protected from atmospheric and other influences, and cannot be short-circuited, and its resistance can be made small in comparison with its size. G. E. A.

1473. *Electrical Resistance of Silicon.* **Miss F. G. Wick.** (Phys. Rev. 27. pp. 11–17, July, 1908.)—A set of silicon rods whose thermo-electric behaviour had previously been investigated [see Abstract No. 275 (1908)] were tested as to their electrical resistance at various temperatures over a range of 600°. The specific resistance varied considerably in the different specimens and is very high, the average value being 58086×10^{-4}. The results of the experiments show also variations in the shapes of the curves representing the change of resistance with temperature. The rods fell into two groups: for one the temperature coefficient of resistance was negative throughout the range measured; for the other the coefficient was negative from the lowest temperature measured to about 200°, at which point a change took place and the coefficient became positive. The resistance of metallic silicon appears to be very sensitive to changes in purity and physical constitution. J. J. S.

1474. *Conduction of Electricity in Metals.* **J. Kinsky.** (Zeitschr. Elektrochem. 14. pp. 406–410, July 24, 1908. Communication from the Physikal.-Chem. Inst. d. Univ., Leipzig. Extract from Dissertation, 1908.)—From the sign of the Hall-effect it seems that electric conduction in metals may, in some cases, be explained by the motion of electrons; in others by the motion of positive ions. It is not certain whether the motion of the latter is accompanied by the movement of matter; if it be, then when current passes from zinc to copper the zinc should decrease in weight and the copper increase, since in copper the current can be looked upon as due to electrons, and in zinc as due in part to positive ions. The experiments fail to put this in evidence. A current is also sent through a barium amalgam which has been carefully prepared so as to be homogeneous, and the amalgam afterwards analysed to see if the portions near the electrodes differ in composition. This also gives negative results. R. S. W.

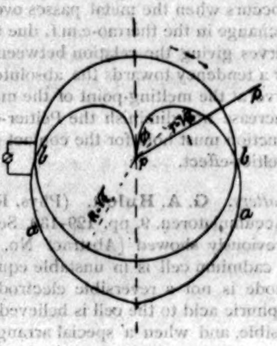
1475. *Thermo-E.M.F. and Peltier-effect with Change from Solid to Liquid State.* **P. Cermak.** (Ann. d. Physik, 26. 3. pp. 521–581, July 7, 1908.)—The author has extended his observations on the dependence of the Peltier-effect on temperature in the case of the combinations iron-constantan and nickel-copper already described [Abstract No. 125 (1908)] to the couples constantan-lead, constantan-tin, constantan-cadmium, and constantan-mercury over wider ranges of temperature; and has in these four new cases investigated whether any change occurs when the metal passes over from the solid to the liquid condition. No change in the thermo-e.m.f. due to melting was noticed in any case. The curves giving the relation between the Peltier-effect and temperature all show a tendency towards the absolute zero-point. There is no change in the curve at the melting-point of the metal. Change of state appears neither to increase nor diminish the Peltier-effect and the thermo-e.m.f. The same deduction must hold for the contact p.d.'s which are simply connected with the Peltier-effect. J. J. S.

1476. *Standard Battery.* **G. A. Hulett.** (Phys. Rev. 27. pp. 33–38, July, 1908. Centralblatt Accumulatoren, 9. pp. 129–130, Sept. 5, 1908. Abstract.) —The author has previously showed [Abstract No. 1682 (1907)] that the kathode system of a cadmium cell is in unstable equilibrium, and has concluded that the kathode is not a reversible electrode. The addition of a certain amount of sulphuric acid to the cell is believed, however, to make the cell completely reversible, and when a special arrangement was devised by which large electrode areas were obtained, it was found possible to construct batteries which were quite reproducible, and the depolariser could be made in the battery after it was set up. A form of battery is described in some detail, which is both simple and effective. In working with a potentiometer, inconvenience was caused by variations in the current, but this was obviated by the use of some of these new batteries which have given an exceedingly constant current, and have practically no temperature coefficient. F. E. S.

1477. *Distributed Capacity in Resistance Boxes.* **A. H. Taylor** and **E. H. Williams.** (Phys. Rev. 26. pp. 417–423, June, 1908.)—The error introduced into alternating-current precision measurements by the distributed capacity of the ordinary non-inductively wound coils of a resistance box was investigated by substituting such coils, in one arm of an Anderson bridge, in the place of a coil practically free from inductance and capacity. The capacity of some 2,000-ohm coils was determined as about 0·0006 mfd., of some coils of 1,000 ohms as 0·00055 mfd., and of some 500-ohm coils as about 0·00016 mfd. The fact that the capacity of the 2,000-ohm coils was but little greater than that of the coils of 1,000 ohms, led to the suspicion that the effect is peculiar to the inner layers of the coils, and this was afterwards verified. The capacity of some 1,000-ohm coils by Leeds and Northrup was measured as 0·00007 mfd., and an investigation was made to discover the cause for the high capacity of the first measured (Wolff) coils. It appears that in order to increase their ability to carry current, the Wolff coils are made of rather large, and hence long, wire. This large surface gives an abnormal value to the distributed capacity, which is still further slightly increased by the fact that, in order to facilitate cooling, the coils are wound on brass cores, so that even after days of baking the inner layer of shellac does not dry thoroughly. This also slightly increases the capacity. While these coils are excellent for direct-current work, it is evident that they possess a serious defect from the standpoint of precise alternating-current measurements. F. E. S.

ALTERNATING CURRENTS AND MAGNETISM.

1478. *Small Periodic Electromotive Forces.* **L. Baumgardt.** (Phys. Zeitschr. 9. pp. 260–263, April 15, 1908.)—Describes a method of obtaining small periodic e.m.f.'s of any desired shape of curve. Two contact wires are mounted in the same plane in a magnetic field perpendicular to the plane. A contact rail passes over them, and the number of lines of force enclosed in the area cut off by the contact rail varies in a manner depending upon the shape of the contact wires. The e.m.f. is taken off at suitable points along the wires. The diagram gives the arrangement for obtaining a zigzag curve of e.m.f. Several other solutions are also given. E. E. F.



1479. *Instrument to Register the Mean Value of an Alternating E.M.F., and a Capillary Electrometer.* **M. G. Lloyd.** (Bureau of Standards, Bull. 4. pp. 525–532, May, 1908. Lumière Électr. 3. pp. 337–338, Sept. 12, 1908.)—In order to register the mean value of an alternating e.m.f. the deflection of the instrument must be independent of the direction of the applied voltage and must be always strictly proportional to it. If the moving element of the instrument were a soft-iron needle surrounded by a coil having so many turns that the smallest measurable current would magnetise it to saturation, then such an instrument would answer the purpose. The practical and theoretical objections against such an instrument would, however, be prohibitive. The author in conjunction with Fisher, by using a rotating commutator in synchronism with an alternating-current generator so that the controlling force is reversed at the proper instants, has succeeded in making such an instrument. Experiments on the use of a capillary electrometer to measure alternating p.d.'s are also described. The results show that it may prove useful as a *detector* of alternating voltages. [Compare Abstract No. 1718B (1904).] **A. R.**

1480. *On the Plug Permeameter.* **C. V. Drysdale.** (Phil. Mag. 16. pp. 132–136, July, 1908. Paper read before the Physical Soc., March 27, 1908. Electrician, 61. pp. 760–762, Aug. 28; Discussion, p. 18, April 17, 1908. Abstract.)—It has been noticed that magnetisation curves obtained by means of the plug permeameter lie below those obtained by other methods. In order to further test this point, rings of various qualities of iron were tested by the "ring method" and then by means of the plug permeameter. For the latter purpose the rings were divided into quadrants, and the two ends of each drilled for insertion of the plug. The curves illustrating the paper confirm the above observation. The tests show that the discrepancy cannot be due to bad magnetic contact between the plug and the specimen, and the author attributes it to the shortness of the cylindrical core as compared with its diam. As the shape of all the specimens is the same, and as the effect does not appear to be influenced by permeability (within the range used in practice), it is possible to correct the scales of the instruments used in conjunction with the plug so as to give results of fair accuracy. [See also Abstract No. 1109 (1902).] **J. D. C.**

1481. *Electric Oscillations and Magneto-elastic Hysteresis.* **L. Tieri.** (Accad. Lincei, Atti, 17. pp. 597–601, May 3, 1908.)—Tables and curves are given showing that a longitudinal magnetisation has the effect of increasing the steepness of the magnetic curve representing a cycle of torsion. As applied to the magneto-elastic detector this would mean that it has a greater sensibility when the wire is longitudinally magnetised by means of a current which creates a resultant field stronger than the earth's field. [See Abstracts Nos. 1616, 1618 (1906).] **L. H. W.**

1482. *Heusler's Magnetic Alloy.* **J. G. Gray.** (Roy. Soc. Edinburgh, Proc. 28. pp. 403–412, 1908.)—Magnetometer tests on specimens of the Heusler magnetic alloy (Cu 62·5, Mn 25, Al 12·5 per cent.) lead to the following conclusions: With increase of temperature the permeability and hysteresis continuously diminish, until at 310° C. the alloy is practically non-magnetic. The permeability in a constant field gradually falls with increasing temperature to zero at 500°. In cooling, magnetic susceptibility reappears at about 350°, but is always much less at the same temperature than before heating to 500°. Repeated heating to 520° resulted in further diminution of permeability after each heating. Much more was lost in the first than in subsequent heatings, but a steady state was not approached after five heatings. Quenching from a high temperature, *e.g.*, 750°, diminishes the permeability considerably; when immersed in liquid air the permeability of the specimen is partially restored. Repeated quenching further diminishes the permeability at each quenching. **F. R.**

1483. *Low-hysteresis Iron Alloys in very Weak Fields.* **E. Wilson, V. H. Winson,** and **G. F. O'Dell.** (Roy. Soc., Proc. Ser. A. 80. pp. 548–552, June 20, 1908. Electrician, 61. p. 721, Aug. 21, 1908.)—The results of ballistic tests of stampings of "Stalloy" and "Lohys" alloys [see Abstract No. 164B (1907)] are given in tables and curves, of which the former are here reproduced. The limiting values of μ appear from the curves to be 260 and 222 for "Stalloy" and "Lohys" respectively. It is interesting to note that the value of $\int HdB/H_0B_{max.}$, where H_0 is the coercive force corresponding to the particular max. value of B, is no longer represented by a linear function of B for very small values of B. The Steinmetz coefficients have also been found; the coefficient β varies between wide limits in the case of each material.

$B_{max.}$	$H_{max.}$	Permeability μ.	Coercive Force H_0.	Residual Magnetism B_0.	Ergs per Cycle per Cubic Centimetre.	$\frac{\int HdB}{H_0B_{max.}}$
			Stalloy.			
0·1267	0·000474	267	—	—	—	—
0·1918	0·000739	259·5	—	—	—	—
0·674	0·00267	252·5	—	—	—	—
0·987	0·00375	263	0·000056	0·015	0·0000111	2·68
1·870	0·00695	269	0·000126	0·040	0·0000672	3·58
3·60	0·01286	280	0·000382	0·10	0·000347	3·17
8·25	0·0251	329	0·0025;	0·73	0·00384	2·34
13·02	0·0358	364	0·0045	1·50	0·01158	2·44
38·0	0·080	475	0·0095	5·00	0·0811	2·82
94·1	0·157	600	0·024	16·50	0·5680	3·12
171·0	0·245	698	0·040	31·0	1·686	3·08
269	0·312	862	0·080	71·5	4·810	2·81
629	0·420	1,500	0·150	246·0	21·65	2·89
2,245	0·677	3,320	0·372	1,478	208·0	3·06
6,050	1·354	4,470	0·60	4,666	1,080·0	3·58
8,200	2·130	3,850	0·67	6,280	1,688	3·86
9,810	3·26	3,020	0·73	7,120	2,335	4·11
1,1500	5·71	2,020	0·75	7,720	3,110	4·54
1,3480	16·20	832	0·80	7,970	4,530	5·28
			Lohys.			
0·70	0·00311	225	—	—	—	—
1·95	0·0087	224	—	—	—	—
4·25	0·0181	235	0·000673	0·21	0·000725	3·18
8·99	0·0352	256	0·00296	0·69	0·00645	3·08
15·0	0·0528	284	0·00675	1·95	0·0224	2·78
37·4	0·1042	359	0·0188	7·00	0·152	2·72
84·1	0·1860	452	0·0445	20·80	0·84	2·82
286	0·404	709	0·133	108·0	8·80	2·92
568	0·565	1,005	0·248	265	32·2	2·89
965	0·697	1,385	0·368	550	83·0	2·94
1,980	0·905	2,185	0·535	1,332	253	3·08
3,780	1·260	3,000	0·700	2,959	725	3·45
6,280	1·960	3,210	0·835	5,187	1,620	3·89
7,970	2·740	2,910	0·920	6,455	2,375	4·08
11,510	6·575	1,757	1·12	8,670	5,060	4·90
13,440	14·90	903	1·25	9,360	7,050	5·29

The specific resistances and temperature coefficients of the alloys have been determined, the mean values being for "Stalloy" 49·63 microhms/cm.³ and 0·000975 (0–50° C.), and for "Lohys" 14·25 microhms/cm.³ and 0·00424 respectively.

L. H. W.

1484. *Magnetic Oxides of Chromium.* **I. Shukoff.** (Comptes Rendus, 146. pp. 1896–1897, June 29, 1908.)—By heating CrO$_3$ or CrO$_2$Cl$_2$, oxides are obtained which are magnetic or non-magnetic according to the conditions of working. It was found necessary to heat to at least 500° or 510° in order to produce a magnetic oxide, and although with the same resulting oxygen content, with varying max. temperatures the product might be either magnetic or non-magnetic, yet the max. of magnetic property occurred when CrO$_3$ was heated to about 510°, and lost from 18·8 to 14·1 per cent. of oxygen. The empirical formula of the product would then be 2CrO$_3$, Cr$_2$O$_3$. Its magnetic transformation-point is 120°–130°. F. R.

1485. *Susceptibility of Bismuth, Copper, Tin, and Copper-Tin Alloys.* **O. C. Clifford.** (Phys. Rev. 26. pp. 424–438, June, 1908.)—With precautions to ensure the absence of iron in all samples, the magnetic susceptibility of bismuth in fields of 200 to 600 was found to be the same as found by other observers for stronger fields. The author's value is $-14{\cdot}08 \pm 0{\cdot}88 \times 10^{-6}$. The values for native copper, tin, and copper-tin alloys are shown in the following table :—

Tin, per cent. ...	0	1·0	7·0	13·8	24·2	33·2	66·4	97·9	100
Copper, per cent.	100	99·0	93·0	86·2	75·8	66·8	33·6	2·1	0
K × 10^{-6}	−1·22	−1·13	−1·40	−1·88	−2·07	−2·06	−1·43	+0·28	+0·31

The minimum occurs at about the composition of speculum metal, but otherwise the curve does not show any marked irregularities corresponding to the compounds in the series. The torsional balance apparatus used is described, and the author intends to proceed with the work in order to find whether some of the alloys of the diamagnetic metals are highly diamagnetic, just as some manganese alloys are highly paramagnetic. F. R.

1486. *Magnetic Elements of the Border Countries of the Western Mediterranean.* **C. Nordmann.** (Comptes Rendus, 146. pp. 1357–1358, June 22, 1908.)—The author supplements the determinations of declination, horizontal component, and inclination made by Moureaux in 1887. This redetermination concerns eleven stations, his new determinations eight stations, these latter in Algiers or Tunis. The irregularities noticed by Moureaux in Algiers are confirmed; the secular variation for Algiers during the period 1888 to 1906 is : declination, −1° 28′ ; horizontal component, +0·0086 ; inclination, −52′. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

1487. *Quantity of Röntgen Rays Absorbed and Transmitted by Successive Layers of Tissue.* **H. Guilleminot.** (Comptes Rendus, 146. pp. 597–599, March 16, 1908.)—In the experiments described a lead screen, provided with an aperture, is placed at a measured distance from a Röntgen-ray tube, and before this aperture portions of tissue of 1 cm., 2 cm., and 3 cm. thickness are fixed, and beyond these the author's fluorometer. This instrument is a binocular arrangement, by means of which a fluorescent screen, opposed to one eye and lighted by the rays from the tube, may be compared with a second screen illuminated by radium, which is seen by the other eye. It is found that when liver substance is used the first cm. absorbs 42 per cent. and allows 58 to pass ; the second absorbs 33 per cent. of the residual rays and transmits 67; the third cm. absorbs 25 and transmits 75. Spleen tissue gives figures which are much the same, but lung tissue and fat absorb a much smaller percentage. [Compare Abstract No. 282 (1908).] H. W. P. Y.

REFERENCES.

1488. *Pure Electromagnetic Fields.* **L. Caffaratti.** (N. Cimento, 15. pp. 369–394, May, 1908.)—Gives some new solutions of the equations governing the spontaneous movement of pure electricity, effected without the movement of matter or linkages between electric charges. The equations are those put forward by Levi-Civita [see Abstract No. 2078 (1907)]. In the new solutions the density of electricity ρ is no longer zero. E. E. F.

1489. *Electron Emission from Glowing Oxides.* **F. Jentzsch.** (Deutsch. Phys. Gesell., Verh. 10. 11. pp. 398–400, June 15, 1908. Physikal. Inst. der Univ., Berlin.)—The Richardson formula has been tested for a large number of oxides and found to hold. The constants of the formula have been calculated in each case, and hence the number of electrons per cm.^{3} and the work to detach an electron have been determined. R. S. W.

1490. *Positive Rays.* **J. Trowbridge.** (Amer. Acad., Proc. 43. No. 20. pp. 513–517, June, 1908. Contribution from the Jefferson Phys. Lab. of Harvard Univ.)

1491. *Simplified Drude's Arrangement for Demonstrating Coupled Systems.* **F. Kiebitz.** (Deutsch. Phys. Gesell., Verh. 10. 10. pp. 386–388, May 30, 1908. Communication from the Kaiserl. Telegraphen-Versuchsamt.)

1492. *Measurement of Damping in Oscillatory Circuits.* **K. E. F. Schmidt.** (Ann. d. Physik, 26. 3. pp. 622–624, July 7, 1908.)—Referring to Wien's article [Abstract No. 960 (1908)] the author would prefer an experimental determination of the best degree of coupling, and then gives a brief account of measurements made under his direction. [See also Abstract No. 961 (1908).] L. H. W.

1493. *Damping of Electric Oscillations for any Degree of Close Coupling.* **B. Mackû.** (Phys. Zeitschr. 9. pp. 437–440, July 1, 1908.)—Expressions are worked out for the current in the oscillatory circuit and applied to the calculation of the reaction of the measuring circuit in the Bjerknes method. **M. Wien.** (Ibid. p. 537, Aug. 15, 1908.)—Wien points out that Mackû's conclusion as to the reaction only differs from his own in the premises and other minor details. [See Abstract No. 960 (1908).] L. H. W.

1494. *Apparatus for Demonstration of Rotating Fields.* **L. Kann.** (Phys. Zeitschr. 9. pp. 445–446, July 1, 1908.)—Gives a description of a mechanical apparatus for representing three-phase currents. The paper does not admit of a short abstract; the original should be consulted by those interested. A. W.

1495. *Electrical Conductivity of Solid Copper Iodide.* **K. Bädeker** and **E. Pauli.** (Phys. Zeitschr. 9. p. 431, July 1, 1908.)—It is found that the conductivity is increased when the iodide is placed in iodine vapour, and is at once decreased when the iodine is removed. [See also Abstract No. 1082 (1907).] **K. Bädeker.** (Ibid. pp. 431–433.)—Conductivity of solutions of the substance is studied. It is also found that the conductivity is increased by light. R. S. W.

1496. *Specific Heat and Molecular Field of Ferromagnetic Substances.* **P. Weiss** and **P. N. Beck.** (Journ. de Physique, 7. pp. 249–264, April, 1908.)—The full paper corresponding to Abstract No. 479 (1908).

1497. *Magnetic Declination and Latitude Observations in the Bermudas.* **J. F. Cole.** (Terrestrial Magnetism, 13. pp. 49–56, June, 1908. Contribution from the Bermuda Biological Station for Research, No. 13.)

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1498. *Physical Aspects of the Atomic Theory.* **J. Larmor.** (Manchester Lit. and Phil. Soc., Mem. 52. 10. pp. 1–54, May 20, 1908. Wilde Lecture. Abstracts in Chem. News, 97. pp. 109–110, March 6, 1908. Nature, 77. pp. 450–452, March 12, 1908.)—A considerable part of present activity in abstract mathematics seems to consist in the construction of schemes of representation such as will elucidate the inner scope and connection of the processes of mathematical thought, involving analysis of the ideas of number and magnitude, limit, infinity, &c. It is significant that both in this and in chemistry some kind of atomism has been a mental necessity. The laws of definite and multiple proportion, the facts of the dispersion of light, and those of crystallography are among those which most decidedly necessitate the conception of an atomic structure. As time goes on it becomes increasingly difficult to resist the direct evidence for the simple view that, in many cases, chemical combination is not so much a fusion or intermingling of the combining atomic structures, as rather an arrangement of them alongside each other under steady cohesive affinity, the properties of each being somewhat modified, though not essentially, by the attachment of the others; and that the space formulæ of chemistry have, therefore, more than analogical significance. Little progress has yet been made towards the dynamical interpretation of the empiric spectrum laws recently discovered, but the primal property of the spectrum as an analytical agent remains unimpaired. Even if the atom itself is intrinsically unfathomed, yet the interaction between atoms separated in space is in its larger features understood, and has its seat in their sub-electric connections with the æthereal medium. The Daltonian molecular theory is still the indispensable guide, if we wish to continue constructive efforts in the physical elucidation of nature, and are not content to take down our scaffoldings for the sake of logical symmetry. While we are certain that molecules are very definite, identical structures, when we inquire into the details of their constitution we have not much more than their distant analogy with familiar dynamical systems to aid us. If the æther should turn out a very complex body we may have to fall back upon pure phenomenalism, and the branches of physical science may cultivate independent modes of explanation, checked only by the mutual conservation of the available energy. E. E. F.

1499. *Atomic Weight of Lead. Preliminary Paper: Analysis of Lead Chloride.* **G. P. Baxter** and **J. H. Wilson.** (Amer. Acad., Proc. 43. No. 12. pp. 865–878, Dec., 1907. Contribution from the Chem. Lab. of Harvard College. Amer. Chem. Soc., Journ. 30. pp. 187–195, Feb., 1908.)—By precipitating lead chloride solution by means of silver nitrate, the authors obtain for the atomic weight of lead, the mean values 207·188 and 207·191 from the ratios $PbCl_2 : 2Ag$ and $PbCl_2 : 2AgCl$ respectively, the atomic weight of silver being taken as 107·93 ($O = 16{\cdot}000$). T. H. P.

1500. *Chemical Reactions in the Magnetic Field.* **G. Berndt.** (Phys. Zeitschr. 9. pp. 512–519, Aug. 1, 1908. Physikal. Laborat. d. Polytechnikums, Köthen, May, 1908.)—Experiments were made upon the influence of the magnetic field upon the solution of iron in nitric, sulphuric, and hydrochloric acids. The apparatus employed consisted of two silvered Dewar vessels, protected from heat radiation by wool and paper, and placed between the poles of an electromagnet excited by a current of 25 amps. The temperature-rise in the reaction mixture was measured yb a thermo-element (Ni-Cu couple) and galvanometer. 5 or 10 c.cm. of the acid was brought into each vessel, and the metal added in the form of fine powder; the rise of temperature of the reaction mixture being observed with and without the excitation of the magnetic field. The chief conclusions drawn from the results of the experiments are as follows: The differences found by Nichols in the heats of solution of iron by HCl and H_2SO_4, with and without excitation of the magnetic field, are due to various sources of error in the method of measurement. Allowing for these errors, the heat of solution is the same in and out of the magnetic field. In the magnetic field the reaction proceeds more quietly owing to the iron particles arranging themselves along the magnetic lines of force, so preventing vigorous motion, and also, perhaps, owing to the particles becoming protected by a stronger solution of ferrous chloride formed round them.

F. J. B.

1501. *Electrometric Determination of the Hydrolysis of Salts.* **H. G. Denham.** (Chem. Soc., Journ. 93. pp. 41–63, Jan., 1908.)—The method employed by the author for determining the amount of hydrolysis in salt solutions consists in measuring the e.m.f. of the element: Pt_{H_2} | salt solution | saturated ammonium nitrate solution | mercurous chloride electrode. This method is especially suitable for use with very dilute solutions, but it cannot be employed with salts of metals less "noble" than hydrogen, nor with multivalent kathions reducible by hydrogen to kathions of lower electrovalency or with reducible anions such as NO_3', ClO_3'. The results show that the hydrogen electrode may be used to determine the hydrolysis of salt solutions even when the concentration of the hydrogen ions is as low as $0{\cdot}3 \times 10^{-6}$. The hydrolytic constant of ammonium chloride proves ammonia to be about 70,000 times as strong a base as aniline. The salts of chromium are hydrolysed about 1·6 times as much as aluminium salts, and Cr may therefore be considered about 1·6 times as weak a base as Al. Nickel salts are more strongly hydrolysed than those of cobalt, and in this connection it is significant that the electro-potential of Co is higher than that of Ni. The salts of Zn, Mg, Ce, Th, Co, and, to a slight extent, Ni exhibit a variable degree of hydrolysis from day to day.

T. H. P.

1502. *Preparation of Pure Carbon Dioxide.* **W. P. Bradley** and **C. F. Hale.** (Amer. Chem. Soc., Journ. 30. pp. 1090–1096, July, 1908.)—Carbon dioxide containing only 0·0025 to 0·0033 per cent. unabsorbable by KOH solution, may be prepared by the action of freshly boiled and cooled H_2SO_4 on acid sodium carbonate, the gas being dried by passage through two U-tubes, the first containing glass beads saturated with concentrated H_2SO_4, the second asbestos fibres thoroughly dusted with P_2O_5. Rubber tubing used for the joints appears to have been permeable to air against pressure.

W. H. Si.

1503. *New Method of preparing Pure Hydrogen.* **Mauricheau-Beaupré.** (Comptes Rendus, 147. pp. 310–311, Aug. 3, 1908.)—The author describes a new method of obtaining pure hydrogen, based upon the decomposition of water at ordinary temperatures by means of specially prepared aluminium.

Finely-powdered Al has added to it a small quantity of mercuric chloride and KCN, the mass becoming slightly warm. The resultant preparation is a coarse metallic powder of apparent density 1·42, and which can be kept indefinitely if out of contact with the moisture of the air. 1 kg. of this powder (now called *hydrogenite*) treated with excess of water will liberate 1,300 litres of hydrogen at 15° and 760 mm. Thus 800 gm. will produce 1 m.^{3}, or 1 dm.^{3} of the powder will give 1,770 litres of hydrogen. For 1 kg. of hydrogenite about 1 litre of water is required. The temperature should not be allowed to exceed 80° C., when the Al will all be oxidised in about 2 hours. The advantage of the method in producing pure hydrogen for aeronautical purposes is pointed out. L. H. W.

1504. *Relative Stability and Constitution of the Dilute Amalgams of the Alkali and Alkaline Earth Metals.* **G. McP. Smith.** (Zeitschr. Anorg. Chem. 58. 4. pp. 381–398, June 23, 1908.)—The results of chemical and electro-chemical experiments show that the metal really exists in solution as a compound whose molecule contains only one atom of the metal. The stability of the mercurides of the triads K, Rb, and Cs and Ca, Sr, and Ba increases with the atomic weight. In equimolecular solutions Li is the most electropositive and Ba the most electronegative, the order being + Li, Ca, K, Rb, Cs, Na, Sr, Ba —. F. C. A. H. L.

1505. *Interaction of Mercury with Alloys of other Metals.* **J. W. Mallet.** (Roy. Soc., Proc. Ser. A. 80. pp. 83–87, Feb. 18, 1908.)—An account of experiments, the results of which tend to show that the relations (capacity for amalgamating or not) of mercury to alloys (of Sn-Pt, Ag-Pt, Cu-Sn) are not the same as to the component metals separately. In the case of the first alloy the Pt prevents the Sn from becoming amalgamated. The Ag in the second alloy brings about solution of the Pt by Hg, whilst in the case of the Cu-Sn alloy the alloying of the metals diminished greatly the readiness with which each metal unites with mercury when separate. L. H. W.

1506. *Causes of Difficulty in Galvanising Iron.* **E. Heyn** and **O. Bauer.** (Königl. Materialprüfungsamt, Mitt. 26. 4. pp. 200–208, 1908.)—Describes a variety of experiments made to determine why difficulty should be experienced in galvanising a particular iron plate. Corrosion tests in hydrochloric acid, and metallographic examination led to the following results: The less easily coated plate had a thicker, and, as it were, more deeply rooted layer of scale adhering to it. This was probably not completely removed by the customary pickling. The grain size of this plate was slightly greater than that of the other, from which different treatment of the two plates is inferred. In right-angle bending tests the behaviour of this sample was improved by annealing at 900° C.; that of the readily coated plate being but little affected. The percentage contents of the plates were as follows: Readily coated plate, C 0·05, S 0·05; plate difficult to coat, C 0·08, S 0·11. It is possible that the difference in behaviour is in part attributable to this difference in composition. F. R.

1507. *Equation of State of Metals.* **M. Thiesen.** (Deutsch. Phys. Gesell., Verh. 10. 11. pp. 410–417, June 15, and 10. 16. p. 604, Aug. 30, 1908. Communication from the Physikal.-Techn. Reichsanstalt.)—Starting with Massieu's fundamental form, $dQ = s d\tau - v dp$, where s is entropy, we have $ds = C d\tau/\tau - \beta dp$, and $dv = \beta d\tau - \gamma dp$. This can be read that the heating of a body by isentropic increase of pressure is proportional to the absolute temperature. Assuming this to hold good for large alterations of pressure we can write $C = A\theta$ and $\beta = B\theta$, where θ is a function of temperature, and A and B are functions of the pressure. Combining and integrating, $C = KAr^{K}$, and $\beta = -dA/dp \cdot r^{K}$, where K is a constant. This gives a simple relation between specific heat, coefficient of expansion and temperature, confirming the result already pointed out by Grüneisen [Abstract No. 1114 (1908)] from experimental data. K appears to be a function of atomic weight; its value for Al is about double that for Pt. Various observers' values of the specific heat and coefficient of expansion of Pt agree as well as could be anticipated with the calculated values. The dimensions of C/β are those of a pressure ($= \pi$, say) and taking the atmosphere as unit, π for $Pt = 1{\cdot}06 \times 10^{6}$. Introducing some approximations the following general equation is deduced: $Q = [ar^{K+1}/(K+1) - p/\delta](1 - Kp/\pi)$. There are four constants, a, K, δ, π. a occurs in the approximate relation $A = a(1 - Kp/\pi)$, and δ is the density at vanishing pressure at absolute zero.

F. R.

1508. *Structure of a Brittle Sheet of very Low Carbon Steel.* **A. Sauveur.** (Electrochem. Ind., N.Y. 6. p. 271, July, 1908.)—The author shows photomicrographs of the steel after heat treatments. The ferrite grains are crossed by a number of dark, wide bands, parallel in the same grain, but in no case crossing the boundaries into adjacent grains. [Probably Neumann's lamellæ.]

F. C. A. H. L.

1509. *Protection of Iron and Steel from Corrosion.* **G. B. Heckel.** (Frank. Inst., Journ. 167. pp. 449–464, June, 1908.)—A review of present knowledge of the subject. The isolation of the surface to be protected demands a coating less permeable by air and moisture than linseed oil alone, but still elastic and adherent; this is best attained by finely grinding the pigments, and by addition of China wood oil, varnish gums, and under certain conditions a neutral heavy petroleum. The insulation of the structure when possible is desirable. Reference is then made to the immunisation against corrosion as studied by Cushman [see Abstract No. 1829 (1908)]. Iron immersed in chromate solutions is immune from corrosion. The use of certain chromates as pigments assists paint in protecting the metal against corrosion, others diminish the protective value of the paint. In this respect zinc chromate is best and chrome-yellow lemon is worst amongst ordinary commercial pigments. The author has obtained confirmatory results as to the immunising effect of a chromate solution. There was little difference in behaviour of boiler-plate drillings from a normal and a quenched piece of the same plate in corrosion experiments. Both samples rusted in distilled water, and neither was affected in dichromate solution. Some suggestions are given for the preparation of anti-corrosive pigments by simultaneous precipitation of two chromates. F. R.

1510. *Segregation of Steel.* **C. L. Huston.** (Frank. Inst., Journ. 165. pp. 371–384, May, 1908. Paper read before the Amer. Soc. for Testing Materials).—Analyses are given showing the distribution of carbon in boiler-plate ingots and in plates rolled from the same or duplicate ingots, and also the tensile strength in the plates. Photographs of sections of the ingots are also given, showing the region of gas-bubbles in what is at present the best location, as far as carbon steel is concerned, viz., some distance below the surface. The data do not admit of useful abstraction, but the following are the carbon percentages at the middle of the height of an ingot, 18 in. × 16 in. × 42 in., starting at the centre of a 16-in. wall and proceeding inch by inch to the centre of ingot: 0·16, 0·16, 0·18, 0·25, 0·25, 0·24, 0·24, 0·23, 0·23, 0·23. The region of gas-bubbles was from 2 to 4 in. from the walls, *i.e.*, in the neighbourhood of max. carbon. It is pointed out that when an ordinary ingot such as this is rolled there is considerably less carbon towards the edges of the resulting plate, and hence the test-pieces, which are usually taken from the edge, show a higher ductility than the rest of the plate would show. When working to specifications of high tensile strength this may lead to the acceptance of plates which, except at the edges, are too hard and hence brittle. It is also proposed that the ductility of plates which are to be used in tension be specified, *e.g.*, in some such rule as the following: tensile strength, 50,000 to 60,000 lbs. per sq. in.; elongation per cent., 1,500,000 ÷ tensile strength. The factor of safety for very ductile steels in tension should be lower than that for less ductile steels. F. R.

1511. *Zinc Blend as a Constituent of Ores.* **K. Friedrich.** (Metallurgie, 5. pp. 114–128, Feb. 22, 1908. Communication from the Metallograph. and Metallurg. Laborat. d. Kgl. Bergakademie, Freiburg.)—An investigation of the systems ZnS with each of the following respectively, PbS, Cu_2S, Ag_2S, FeS by thermal and micrographic methods. The limiting percentages of ZnS, on account of volatilisation, are 40, 80, 80, 56 respectively. The eutectic points in the systems containing PbS, Ag_2S, FeS occur with 6, 8, and 5 per cent. ZnS respectively, at temperatures 70°, 86°, and 10°–20° C. below the solidification-points of the respective sulphides. It appears that in all cases undissolved ZnS occurs in samples containing much ZnS. The observations are applied to a consideration of the ordinary sulphide ores. F. R.

1512. *Iridium Crucibles.* **W. Crookes.** (Roy. Soc., Proc. Ser. A. 80. pp. 535–536, June 10, 1908.)—Describes a series of tests with crucibles of wrought iridium, supplied by Johnson and Matthey. Iridium is as hard as steel, and the crucible is almost unaffected by any reasonable mechanical treatment. Brightly polished Ir superficially oxidises with a bluish colour when heated to redness, but is again reduced on raising the heat, no appreciable alteration in weight being caused. Unlike Pt, the crucible is unaffected when heated over a Bunsen burner insufficiently supplied with air, and the deposit of carbon easily burns away. Iridium does not blister after long use, and it is unaffected by sulphur in the gas. The crucible shows no appreciable loss of weight after several hours' boiling in *aqua regia.* Various mixtures of phosphates and carbon have no effect, and silica and silicates, with a reducing agent, may be heated strongly in it for some time without forming a silicide or affecting the crucible. Caustic potash fused at a red heat attacks the crucible, but not so strongly as it would have attacked Pt under the same conditions. Lead and zinc have been melted and partly boiled away in the crucible, leaving it unaffected. Copper melted in the crucible for some time makes it "hot rotten," but if the copper is well burnt off at a high heat the iridium reverts to its original condition. Nickel, gold, and iron can be melted and kept liquid in the crucible for some time and then poured off without injury to the crucible. It is proposed to experiment with crucibles of rhodium, ruthenium, and osmium. The latter two metals have so far not been successfully fashioned into crucibles. Rhodium has been found practically as resistant as Ir, and its low density (11 as against Ir 22) would be a great advantage in quantitative operations. C. O. B.

1513. *Occluded Gases in a Nickel Steel.* **G. Belloc.** (Comptes Rendus 147. pp. 244–245, July 27, 1908.)—The gases occluded in two samples (wire, and turnings from an ingot) of the same steel, containing 0·15 per cent. carbon and 45 per cent. Ni, were studied by the method used in the work referred to in Abstract No. 1584 (1908). They consisted of CO_2, CO, H and N. CO_2 was entirely liberated below 520°, and the evolution of N only commenced above this temperature. The total volume of gas evolved from the turnings was 8·5 times the volume of the metal, and the rate of evolution was practically the same at all temperatures. The wire gave up a total of ten times its volume of gas, at a rate which reached a well-marked max. at 540° and another at 880°. The proportions of the different gases evolved at increasing temperatures were somewhat irregular. To explain the differences between the rates of evolution of gas from the wire and turnings respectively, it is noted that as the transformation temperature of this reversible alloy would be at about 350° or 400°, the greater proportion of gas is evolved whilst the iron is in the γ and the nickel in the β state. Several other hypotheses, however, are suggested as possible explanations of the difference between the volumes of gas evolved by the two samples. F. R.

1514. *Surface Tension of Dilute Aqueous Salt Solutions.* **A. Heydweiller.** (Deutsch. Phys. Gesell., Verh. 10. 6. pp. 245–248, March 30, 1908.)—Grüneisen has resolved the viscosity of a salt solution into quantities depending on the ionised and on the non-ionised portions of the salt. The author finds that in a series of chlorides the effect of the non-ionised part changes with rising molecular weight of the salt from a positive to a considerable negative value, whilst the effect of the ionised part is always positive. T. M. L.

1515. *Physical Properties of a True Solution of Starch.* **E. Fouard.** (Comptes Rendus, 146. pp. 978–981, May 11, 1908.)—A "perfect solution" of starch may be obtained by filtering a pseudo-solution of partially demineralised starch through a collodium membrane. Cryoscopic measurements show the molecular depression of such a solution to be *nil*, an approximation of the order of 1/1000 of a degree indicating a minimum molecular weight of 15,000, which corresponds to an aggregation of 45 molecules of maltose. From an ultramicroscopical examination the elementary mass of the dissolved starch appears less than that in colloidal solution. Filtration of 5 per cent. pseudo-solutions through membranes in which the alcohol proportion was varied, rendering the texture less compact, has given solutions containing from 1·518 to 2·365 per cent. starch, and having $[\alpha]_D$ ranging from 183° 15′ to 191° 50′. A perfect solution passed through a collodion membrane, on concentration, either at 60° C. or *in vacuo* at 15°, and dilution, loses some 10 to 30 per cent. starch when refiltered through the membrane, from which it is inferred that water exerts some influence on the molecular structure of the starch molecule. The filtrate from a concentrated and rediluted solution, on ageing under sterile conditions, does not become granular as does an unconcentrated solution. The electrical conductivity of a perfect solution increases continuously during the transformation into granules from $78{\cdot}4 \times 10^{-6}$ up to a constant maximum of $226{\cdot}7 \times 10^{-6}$, which is reached when the rupture of the original molecules into smaller ones is complete. W. H. Si.

1516. *The Equivalent-conductance of Hydrogen-ion derived from Transference Experiments with Nitric Acid.* **A. A. Noyes** and **Y. Kato.** (Amer. Chem. Soc., Journ. 30. pp. 318–334, March, 1908. Contribution from the

Research Lab. of Phys. Chem. of the Mass. Inst. of Technology, No. 21.)—Previous experiments [Abstract No. 218 (1904)] on the transference during electrolysis of the ions of hydrochloric acid in very dilute solutions revealed a contrast between the values for the mobility of the hydrogen-ion when derived by taking the *ratio* H : Cl from the transference experiments (H = 330) and those deduced by taking the *sum* of the mobilities H + Cl from Kohlrausch's conductivity measurements (H = 318). Both values have been confirmed by later experiments, and there can be no doubt as to the reality of the discrepancy, which is not due either to experimental errors or to the presence of impurities. The present paper contains an account of a series of similar experiments in reference to ionic transference in dilute solutions of nitric acid. These have given precisely similar deviations, and it is therefore clear that these are due to the hydrogen and not to the acid radical. By assuming that the $\overline{Cl}$ and $\overline{NO_3}$ ions maintain a constant mobility at dilutions from 0·06-N onwards it is possible to deduce from the two series of experiments concordant values for the mobility of the hydrogen-ion, but *these exhibit a progressive decrease in magnitude as the concentration decreases*—a result that is of fundamental importance in all experiments involving the conductivity or the coefficient of ionisation of any of the acids. The values obtained were as follows :—

Concentrations.		Transference Numbers.		Mobility of Hydrogen-ion.	
HNO_3.	HCl.	HNO_3.	HCl.	HNO_3.	HCl.
0·058-N	0·051	0·1557	0·1660	350·3	344·2
0·0184	0·017	0·1596	0·1675	340·2	340·5
0·0067	0·0056	0·1600	0·1671	339·1	341·4
0·0022	0.0021	0·1628	0·1711	332·2	331·8
0	0	[0·1600]	[0·1745]	324·6	324·0

The mobilities for infinite dilution are derived by subtracting those for Cl and NO_3 (assumed constant at 68·5 and 64·6) from the limiting values for the molecular conductivity. It will be noticed that the mobility is practically stationary from 0·018-N to 0·006-N ; this is regarded as being a "normal" value, which is modified by some new factor at extreme dilutions, as well as by more ordinary causes (viscosity, &c.) when the concentration is increased. Two important consequences of the variable mobility of the hydrogen-ion are indicated : (1) The decrease at high dilutions in the conductance of strong acids may be due, in part at least, to this cause, and need not therefore be attributed wholly to impurities. (2) The coefficient of ionisation of HCl at 0·05-N must be lowered from 0·948 to 0·900—a value which may be compared with 0·891 for KCl and 0·874 for NaCl ; the acid has therefore practically the same coefficient as the salt, instead of a coefficient considerably higher.

T. M. L.

1517. *Vapour-pressure of Dry Ammonium Chloride.* **F. M. G. Johnson.** (Zeitschr. Phys. Chem. 61. 4. pp. 457–468, Jan. 21, 1908.)—A special form of manometer is described in which the pressure is used to produce an unwinding of a glass spiral, which is magnified and made visible by a mirror attached by a thread to the lower end of the spiral. This has the advantage that the substance examined does not come into contact with mercury. In practice a zero method was used, the pressure outside the spiral being varied by means of mercury columns until the spiral showed by its return to the zero position that the pressure was the same inside and out. The apparatus was tested by determinations of the vapour pressure of iodine, and was found to give results identical with those of Ramsay and Young. Experiments with dry ammonium chloride were then carried out, and led to the remarkable result that the vapour pressure of the dry salt vapourising without decomposition was identical with that produced when the salt is sufficiently moist to dissociate. T. M. L.

1518. *Calculation of Hydrocarbon Equilibria.* **H. v. Wartenberg.** (Zeitschr. Phys. Chem. 61. pp. 366–372, Dec. 3, 1907. Phys. Chem. Inst. d. Univ., Berlin.)—The author shows by means of thermochemical calculations, based on a formula of Nernst, that the main gaseous product of the interaction of carbon and hydrogen at, say 800°, would be methane CH_4. At 900° both methane and ethylene tend to pass into acetylene, but, on the other hand, at 800° there is a tendency for ethylene to take up hydrogen and pass into ethane—a change that can actually be realised in presence of platinum or nickel-powder; the thermochemical data show, however, that there is no tendency for ethylene at 170° to take up water and produce alcohol. At high temperatures there is a marked tendency for ethylene to produce methane and liberate carbon—a process which is probably of great importance in the production of luminous flames; but methane in its turn tends to break up into carbon and hydrogen, as is shown by the formation of carbon and hydrogen in gas retorts. T. M. L.

1519. *Weight of a Falling Drop and the Laws of Tate. Determination of the Molecular Weights and Critical Temperatures of Liquids by the Aid of Drop Weights.* I. **J. R. L. Morgan** and **R. Stevenson.** II. **J. R. L. Morgan** and **E. Higgins.** (Amer. Chem. Soc., Journ. 30. pp. 360–376, March, and pp. 1055–1069, July, 1908. Contributions from the Havemeyer Lab. of Columbia Univ., Nos. 149 and 152. Zeitschr. Phys. Chem. 63. 2. pp. 151–170, June 16, 1908.)—I. A capillary burette is described by means of which it was possible directly to measure the volume of the pendant drop, the clinging drop, and by difference the falling drop from the end of a glass tip. Only the falling drop was found to be directly related to surface tension, but in this case the relationship was an exact one, the ratio of the weight of the drop to the surface tension being subject to an average error of less than 1 per cent. In order to secure accurate results, however, it is essential to use a properly constructed tip on which the drop may form. The type generally used was bevelled at an angle of 45° round the outer edge, but tests with other patterns are described. For bevelled tips from 4·68 to 7·12 mm. in diam. the weight of the drop was found to be proportional to the diam. of the tip. Experiments at different temperatures gave results identical with those of Ramsay and Shields in determining the factor of association and the critical temperature of the liquid. II. (1) By using a capillary burette of smaller internal diam., and the same "tip" as in Part I., the accidental error in estimating the volume of a drop is reduced to a few hundredths of 1 per cent., though the constant errors may be considerably larger. (2) Drop-weights calculated from the experimentally determined volumes by the use of new density values for benzene, chlorobenzene, carbon tetrachloride, pyridine, aniline, and quinoline at the same temperatures as previous measurements by the rise of level in capillary tubes, have given in each case a strictly linear relationship between drop-weights and temperature, whereas the surface-tension values determined by capillary rise are scattered irregularly on either side of the line; the drop-weight method is therefore capable of considerably greater accuracy than that previously employed. (3) The temperature coefficients of molecular surface energy, used by Ramsay and Shields to calculate critical temperatures and coefficients of association, are much more constant when applied to drop-weights (average error 0·1 per cent.) than to smoothed values deduced from capillary rise (Renard and Guye, average error 3 per cent.).

	Constant. (Morgan and Higgins).	Crit. Temp. (Morgan and Higgins).	Constant. (Renard and Guye).	Crit. Temp. (Renard and Guye).	Crit. Temp (obs.).
Benzene	2·569	288·4	2·12	287·7	288
Chlorobenzene	2·569	359·5	2·10	357·7	360
Carbon-tetrachloride ...	2·567	285·2	2·19	278·0	284
Pyridine	2·567	347·0	2·07	346·2	344
Aniline	2·569	425·8	2·01	448·6	426
Quinoline	2·575	520·4	2·21	496·2	< 520

Indeed, the drop-weights, when determined over a considerable interval, lead to values for the molecular weights of liquids such as the above which are inferior in accuracy only to those derived from direct observations of the density of gases. T. M. L.

1520. *Laboratory Separation of Minerals by the Electromagnet.* **A. Chevallier and L. Vérain.** (Comptes Rendus, 146. pp. 487–489, March 2, 1908.)—The authors have modified Fouqué's apparatus in two details of construction. The electromagnet is fixed horizontally and the lower of the pole-pieces is replaced by a small circular plate of soft iron, while the upper one terminates in a point of the same soft iron. The plate has a diam. of 0·04 m., while the point is a truncated cone with a slightly convex end 0·05 m. in diam. The grains of mineral must be all equal in size, and they are brought within the magnetic field by spreading upon a sheet of paper and supporting this upon the circular pole-piece of the magnet. With a resistance composed of lamps of 5, 10, 16, 32, and 50 c.p., arranged in series, it is possible to obtain practically all the variations in current and e.m.f. required with a 220-volt circuit. In order to make use of this apparatus for the laboratory separation of minerals, it is necessary to prepare a table giving the current and resistance required for the different iron-bearing minerals in the pure state with the particular electromagnets used. The authors have obtained experimentally, with their own apparatus, the following values: Sidérose, 0·17 amp.; grenat, 0·25 amp.; péridot, 0·47 amp.; cordiérite, 0·59 amp.; white mica from the Vosges containing only 1·5 per cent. iron oxide, 0·95 amp. The authors have also determined synthetically the relation which exists between the percentage of iron in any mineral and the inductive force necessary to attract it. The results plotted as a curve upon squared paper take the form of an equilateral hyperbola. The use of this method of mineral separation in the laboratory offers many advantages and great saving of time as compared with the older methods. The study of sedimentary and crystalline rocks and minerals is much simplified, since it is possible to concentrate to some extent the individual component parts of the mineral. One most important feature of the method is that it is possible to determine quickly and without the use of analytical methods the percentage of iron present in any mineral simply by noting the intensity of the current necessary to attract it. J. B. C. K.

1521. *Ammonia Equilibrium.* **F. Jost.** (Zeitschr. Anorg. Chem. 57. 4. pp. 414–430, March 27, 1908.)—The partial pressures of ammonia formed from nitrogen and hydrogen in the proportion $N_2 : 3H_2$ at 1,000°, as determined by Haber and van Oordt [Abstracts Nos. 1165, 1835 (1905)], are much smaller than the values calculated by Nernst. The author describes new measurements made by means of Nernst's electric pressure furnace, the pressures employed being 50–70 atmos. and the catalysts Pt-foil or finely-divided Fe or Mn. The values obtained for the partial pressure, x, of the ammonia formed at atmospheric pressure between 700° and 1,040° are expressed by the formula: $\log x = 3065/T - 6{\cdot}918$, T representing the absolute temperature. The heat effect, calculated on the assumption that it varies little with the temperature, is 28,020 cals. (per $2NH_3$), the values 24,000 and 24,400 cals. being given by Thomsen and Berthelot respectively [see next Abstract]. T. H. P.

1522. *Equilibrium of Ammonia under Pressure.* **F. Haber** and **R. Le Rossignol.** (Zeitschr. Elektrochem. 14. pp. 181–196, April 10, 1908. From the Inst. f. Physikal. Chemie u. Elektrochemie der techn. Hochschule, Karlsruhe.)—The results of Haber's previous determinations [Abstracts Nos. 1165, 1835 (1905)] of the equilibrium conditions of ammonia at atmospheric pressure do not agree with those obtained by Nernst and Jost at temperatures between 685° and 1,040° and pressures of from 12 to 70 atmos. [see preceding Abstract]. The results of further measurements at 30 atmos. give the following mean results obtained by approaching the equilibrium conditions from both sides:—

Temperature.	Per Cent. of NH_3 formed.	$K_p \times 10^4$
700°	0·654	6·80
801	0·344	3·56
901	0·207	2·13
974	0·144–0·152	1·48–1·56

The equilibrium constant K_p represents the ratio of the partial pressures of the gases: $K_p P = 100(NH_3)/(N_2)^{\frac{1}{2}}(H_2)^{\frac{3}{2}}$, P being the total pressure. The above values, which the authors regard as correct to within 2·5 per cent., are in good agreement with the authors' previous results, but do not agree with the values given by Nernst's theoretical calculations. It is suggested that this disagreement is due to an error in the value of the heat of formation employed by Nernst, or to an increase in the specific heat of ammonia at high temperatures. **F. Jost.** (Ibid. p. 373 and pp. 513–514.)—A criticism, and Haber and Le Rossignol's reply. T. H. P.

1523. *Conductivity and Ionisation of Salts, Acids, and Bases in Aqueous Solutions at High Temperatures.* **A. A. Noyes** [with **A. C. Melcher, H. C. Cooper, G. W. Eastman,** and **Y. Kato**]. (Amer. Chem. Soc., Journ. 30. pp. 335–353, March, 1908. Contributions from the Research Lab. of Phys. Chem. of the Mass. Inst. of Technology, No. 22.)—The author here summarises the results of a series of experiments, extending over some years, which have been published in the form of a large volume (Publication, No. 63), by the Carnegie Institution of Washington, but have not previously been published in a journal or abstracted. The experiments were made in a bomb, lined with Pt, at temperatures up to 306°, and at concentrations ranging from 0·1 to 0·002 normal. The electrolytes examined, in addition to sodium and potassium chlorides, were acetic, hydrochloric, nitric, sulphuric and phosphoric acids; ammonium, sodium, and barium hydroxides; ammonium chloride and acetate, sodium acetate, silver nitrate and magnesium sulphate; barium nitrate, potassium sulphate, and potassium hydrogen sulphate.

I. *Results in Reference to Equivalent Conductance and Ionic Mobility.*—The values of the equivalent conductance at infinite dilution (Kohlrausch's Λ_0), increase enormously when the temperature is raised, *e.g.* :—

	KCl.	$NaCl$.	NH_4Cl.	HCl.	$AgNO_3$.	$Ba(NO_3)_2$.	K_2SO_4.
18°	130	109	131	379	116	117	133
306°	1,120	1,080	1,176	1,424	1,065	1,300	1,725
S/KCl	1·00	0·96	1·05	1·27	0·95	1·16	1·54

There is, however, an extremely strong tendency for the mobilities to become equal for all the different ions when the temperature is raised; this is clearly shown by the last row of figures in the table, which represent the ratio of the equivalent conductance of each substance at 306° to that of potassium chloride at the same temperature. In the case of all the strong binary electrolytes the values at 306° are within 5 per cent. of those for potassium chloride with the exception of hydrochloric acid and sodium hydroxide, which give exceptionally high values at 18°, and sodium acetate, which gives a very low value at 18° and is derived from a very weak acid. In the case of barium nitrate and potassium sulphate the equivalent conductance rises to much higher values than in the case of the (univalent) binary electrolytes, *e.g.*, the ratio for K_2SO_4/KCl at 306° is 1·5; this apparently abnormal result is really a strong confirmation of the equal resistance experienced by all the ions when moving through the solution at high temperatures, for in the case of these ternary electrolytes the electrical forces available for moving the doubly charged ion in $\overset{++}{\mathrm{Ba}}$ or $\overset{--}{\mathrm{SO_4}}$ is twice as great as in the case of a univalent ion; the velocity of the bivalent ion should therefore be twice as great, and the equivalent conductance of the salt is 1½ times that of a binary salt like KCl. The fact that at ordinary temperatures the $\overset{++}{\mathrm{Ba}}$ and $\overset{--}{\mathrm{SO_4}}$ ions move with much the same velocity as $\overset{+}{\mathrm{K}}$ and $\overset{-}{\mathrm{Cl}}$ has been attributed by Morgan and Kanolt to the greater hydration of the bivalent ions. In the case of the acids and bases the equivalent conductance increases less and less rapidly as the temperature rises, owing to the slow rate of increase for the ions $\overset{+}{\mathrm{H}}$ and $\overset{-}{\mathrm{OH}}$; but in the case of the tri-ionic salts it increases more and more rapidly owing to the great increase in conductance of the bivalent ion; the curves for the former are therefore concave to the axis of temperature and droop towards it, whilst those for the latter are convex and curve away from it. In the case of the neutral binary salts the curve is at first convex, then concave and again convex, with two intermediate points of inflection at 100° and 156°; it is, however, noteworthy that up to 156° the equivalent conductance is practically proportional to the fluidity of the solvent, the average value of the product $\eta\Lambda_0$ for 5 salts being 1·19 at 18°, 1·04 at 100°, and 1·01 at 156°—a variation that is of small importance seeing that the conductance values increase five-fold in the range of temperature.

II. *Results in reference to Ionisation.*—It was found that between the concentrations 0·1 and 0·002 or 0·0005-N the change of equivalent conductance for all salts (binary and ternary) could be expressed by the formula $C(\Lambda - \Lambda_0) = K(C\Lambda)^n$, where the value of n varied with different substances between 1·40 and 1·55. If the ratio Λ/Λ_0 be taken as a true measure of the ionisation γ, the equation becomes $(C\gamma)^n/C(1-\gamma) = \text{const}$. In a previous article emphasis has been laid on the remarkable fact that at ordinary temperatures the form of the functional relation between ionisation and concentration is the same for salts of different ionic types; the results now described show that this is also true at high temperatures, and moreover that even the large variation of temperature and consequent change in the character of the solvent have hardly any effect on the numerical value of the exponent n. As the simple laws of mass-action require an index $n = 2$ for binary salts and $n = 3$ for ternary salts, in place of $n = 1·5$ observed, it is evident that other factors come into play in determining ionisation. Acetic acid and ammonia, on the other hand, give the theoretical index $n = 2$ right up to 306°, and phosphoric acid gives $n = 1·8$ to $2·0$. With the exception of pure water (up to 270°) and a few weak acids and bases up to 40°, ionisation decreases with rising temperature, the average coefficients, $-10^{-3}\Delta\gamma/\Delta t$, being, for different types of salts, as follows:—

	18 to 100°.	100 to 156°.	156 to 218°.	218–281°.	281–306°.
Di-ionic......	0·32	0·55	0·68	1·09	2·84
Tri-ionic ...	0·34	0·94	1·23	2·30	3·20

The variations from the mean do not exceed about 3 per cent. The curves showing the relationship between ionisation and temperature drop rapidly at the higher temperatures, and might very well extrapolate to zero ionisation at the critical temperature, 360°, of the solvent. There appears to be a close relationship between the decay of ionisation and the diminution of the specific inductive capacity of the solvent, but as the latter has only been measured up to 76° it was not possible to make an extended comparison.

III. *Theoretical Conclusions.*—After noting the equal ionisation of salts of similar ionic type, the parallel effect of temperature on ionisation and specific inductive capacity, the extended validity of a common exponential relation between ionisation and concentration for all types of salts, and the constancy of the molecular refraction of dissolved salts at varying concentrations, the author concludes "that the ionisation of salts, strong acids, and bases is a phenomenon primarily determined not by specific chemical affinities, but by electrical forces arising from the charges on the ions; that it is not affected (except in a secondary degree) by chemical mass-action, but is regulated by certain general, comparatively simple laws, fairly well established empirically but of unknown theoretical significance." He assumes that the ions may unite in two ways to form either chemical molecules (governed by the law of mass-action) or electrical molecules (formed according to the above empirical law) in which the ions are loosely held together but retain their individual charges; weak electrolytes are those in which the tendency to produce chemical molecules predominates; in strong electrolytes the electric molecules are the chief product. T. M. L.

1524. *Dissociation Pressure of certain Metallic Hydroxides and Carbonates.* **J. Johnston.** (Zeitschr. Phys. Chem. 62. 3. pp. 330–358, March 31, 1908.) —A static method of measuring the dissociation pressure of certain hydroxides and carbonates was devised, and the decomposition pressures of the hydroxides and carbonates of Ca, Ba, Sr, Li, Mg, and Na were measured over a considerable range of temperature. The results showed that when these elements are arranged in the order of ease of decomposition of the above compounds, the order is that expected from the Periodic Law. Further, the observed heat of formation of the hydrates agreed with that calculated from the dissociation-pressure curves, but not with that calculated from Nernst's approximation formula. A theoretical foundation for the formula of

Ramsay and Young is given, and it is shown that the linear relationship between corresponding temperatures admits of general application, and that it can be applied to interpolation and extrapolation with advantage. F. J. B.

1525. *Binary Electrodes and Electrochemical Adsorption.* **L. Michaelis.** (Zeitschr. Elektrochem. 14. pp. 353–355, June 26, 1908.)—Defining an electrode as a body which can give up ions to a solution, the author shows that a sparingly soluble solid acid can then be regarded as an electrode, because it gives hydrion and acid ions. As the hydrion moves faster than the anion an electric p.d. is set up, or, in other words, the solid acid assumes a negative charge relatively to the solution. When acid is added to the solution, however, this potential will be diminished, owing to the hydrion concentration being lowered. The surface tension of the solid will therefore be raised. This is applied to colloids—*e.g.*, mastix—which gives off hydrion. When methyl violet, or base, is added to this we get a salt formed, which may be regarded as one electrode dipping in water containing methyl-violet ions. The "adsorption" of the methyl violet will go on until the potential is equal to the potential between the mastix and the liquid. The author thus explains electrochemically the adsorption of solutes by colloids. A. F.

1526. *Electrolytic Rectification of Alternating Currents.* **G. Schulze.** (Zeitschr. Elektrochem. 14. pp. 333–347, June 19, 1908. Communication from the Physikal. Techn. Reichsanstalt.)—The author has already given his conclusions as to the nature and mode of action of the anode film [Abstracts Nos. 156, 924, 1260, 2120 (1907)]. The gas layer in the effective direction has a resistance of the order of 500 ohms/dm.^{2} and a capacity of order 5 mfd./dm.^{2}; so that with an alternating current of 50 ∿ the value of $1/\omega C$ is 640 ohms/dm.^{2}. In the reverse direction the gas layer and the electrolyte have each a resistance of order 10 ohms/dm.^{2}. A large number of oscillograms are reproduced in the original, taken when using electrodes of all the active metals. These curves agree well with the forms theoretically deduced. As defining the relative values of different cells the ratio of the apparent resistances in the anode (r_a) and kathode (r_k) directions is employed. This ratio r_k/r_a is called α. For Al, α is small in solutions of salts of Na or K, but the layer soon breaks down. With ammonium salts there is less liability to break down, but α is greater. Breakdown does not occur with Ta, but α is too large, while the capability of withstanding high voltages (1,000 volts) is confined to very dilute solutions. For Mg, α is very small, but the effect of heating is too marked. No combination has as yet been found which shows both a small value of α and security against breakdown. The author hence concludes that there is not much of a future for such cells as rectifiers, though they are more hopeful as protective devices or as condensers. Thus in a vessel of dimensions 40 × 40 × 40 cm., using Al plates and a max. voltage of 160, a capacity of 5,000 mfd. can easily be obtained. At 50 ∿ and 160 volts (max.) the max. value of the capacity current would be 250 amps., the capacity reactance 0·637 ohm, while the ohmic resistance would probably work out at 100 ohms. [See also Abstract No. 1205 (1908).] L. H. W.

1527. *Kathode Volatilisation in Rarefied Gases.* **F. Fischer** and **O. Hähnel.** (Zeitschr. Elektrochem. 14. pp. 366–367, July 3, 1908. Preliminary communication from the Chem. Inst. d. Univ., Berlin.)—Arranging experiments like those of Kohlschütter and Goldschmidt [see Abstracts Nos. 1273 (1906) and 1014 (1908)] in a different way, the authors come to entirely different conclusions. Kohlschütter used one tube in series with a milliammeter and a titration coulombmeter for measuring the current in the secondary of an induction apparatus; the authors place two equal tubes in series. In that case each of the metals Zn, Cd, Sn, Sb, Bi, Al, Fe, Ni, Cu, Pt, Ag, is disintegrated to the same amount in the two gases, H and A, for equal gas pressure and current density; Al requires much greater current intensities than the other metals, the order being Al, Fe, Ni, Cu, Pt, Ag; as explained, the order is the same for the two gases, H and A. When the gases contain air, less metal is volatilised; argon is particularly sensitive in this respect. The volatilisation increases approximately as the square of the current intensity, and is inversely proportional to the gas pressure. When the figures of Kohlschütter are calculated for equal current intensities, the order of the gases, in which they attack metals, is by no means that of their atomic weights. When two tubes are coupled in parallel, however, the argon tube shows a much greater volatilisation of metal than the hydrogen tube; that is because the current chiefly passes through the argon; with higher potentials, however, the differences vanish. There is no proof that the noble gases form any compounds. H. B.

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1528. *Atomic Weight of Radium.* **T. E. Thorpe.** (Roy. Soc., Proc. Ser. A. 80. pp. 298–309, May 5, 1908. Bakerian Lecture for 1907. Chem. News, 97. pp. 229–233, May 15, 1908.)—The mean value of the atomic weight determined by the author is 226·7. L. H. W.

1529. *The Problem of Chemical Affinity.* **W. D. Bancroft.** (Journ. Phys. Chem. 12. pp. 75–137, Feb., 1908. Paper read before the Amer. Chem. Soc., Toronto.)

1530. *Distribution of Scandium on the Earth.* **G. Eberhard.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 38. pp. 851–868, 1908.)—Gives a list of 366 minerals from various sources, in only about one-third of which no trace of the scandium lines was visible when vapourised in the electric arc. The wide and general distribution of scandium is thus made clear. L. H. W.

1531. *Electric Furnace for Determination of Carbon in Steel, &c.* **C. M. Johnson.** (Amer. Chem. Soc., Journ. 30. pp. 773–779, May, 1908.)—The fused quartz combustion tube is placed inside the tube of an ordinary design of wire-wound tube resistance furnace, instead of being heated by gas. The sample is treated in silica-lined clay or porcelain boats. The main advantages claimed are those generally attributed to electric heating—economy of space, time, and labour, and control of temperature. F. R.

1532. *Testing Alloys.* **W. B. Parker.** (Engineering, 86. pp. 53–57, July 10, 1908. Paper read before the British Foundrymen's Assoc., Birmingham Branch, May 23, 1908.)—A general outline. Results of tests of specimens cut from broken bronze propellers are given. It is stated that 14 tons per sq. in. is about the max. elastic limit, and 9 tons the mean, for this class of alloys. F. R.

1533. *The Blast Furnace Diagram.* **C. Brisker.** (Stahl u. Eisen, 28. pp. 391–397, March 18, 1908.)—Combining the curves of Boudouard and of Baur and Glässner for the reactions (1) $2CO \rightleftharpoons CO_2 + C$, (2) $Fe_3O_4 + CO \rightleftharpoons 3FeO + CO_2$, (3) $FeO + CO \rightleftharpoons Fe + CO_2$, a curve is obtained for the relation between the percentages of CO and CO_2 and temperature for the blast furnace. This is applied to published data. F. R.

1534. *Occluded Gases in Steel.* **G. Belloc.** (Soc. d'Encouragement, Bull. 110. pp. 492–515, April, 1908.)—A more complete account of the work referred to in Abstract No. 812 (1908), with description of methods and curves. F. R.

1535. *Molecular Weight and Conductivity Determinations in Nitrobenzol.* **E. Beckmann** and **G. Lockemann.** (Zeitschr. Phys. Chem. 60. pp. 385–398, Sept. 24, 1907.)

1536. *Anomalies in the Viscosity of so-called Crystalline Liquids at the "Clearing" Point.* **E. Bose** and **F. Conrad.** (Phys. Zeitschr. 9. pp. 169–173, March 1, 1908.)—The authors have determined the relative values of the viscosity of anisaldazine ("clearing" temperature 180°) at temperatures varying from 169·9° to 193·9° to test the suggestion that the values would exhibit a "break"; the results show that there is no isothermal discontinuity, and are therefore opposed to the view that the "clearing" temperature is a true transformation temperature. D. H. J.

1537. *Molecular-Kinetic Theory of Opalescence of Gases.* **M. Smoluchowski.** (Acad. Sci. Cracovie, Bull. 10. pp. 1057–1075, Dec., 1907. Ann. d. Physik, 25. 2. pp. 205–226, Feb. 7, 1908.)—A mathematical discussion of the conditions necessary to produce the well-known opalescence which is seen in gases in the critical condition, and has recently been studied in detail by Travers and Usher [Abstract No. 83 (1907)]. T. M. L.

1538. *Experiments on the Rôle of Imbibition in the Osmosis of Liquids.* **G. Flusin.** (Annal. Chim. Phys. 13. pp. 480–522, April, 1908.)—The conclusion is drawn that there is a quantitative, as well as a "conditioning" or qualitative relationship between osmotic phenomena and the imbibition of the solvent or solution by the membrane, and that osmosis depends on semi-chemical affinities rather than on the physical properties of the membrane and liquids. T. M. L.

1539. *Osmotic Pressure of Compressible Solutions of any Degree of Concentration. Part II. Cases in which both Solvent and Solute are Volatile.* **A. W. Porter.** (Roy. Soc., Proc. Ser. A. 80. pp. 427–465, June 10, 1908.)—This is an extension of a previous paper [Abstract No. 856 (1908)], in which formulæ are obtained for the osmotic pressure of solutions of a volatile solute in a volatile solvent. A. F.

1540. *Note on the Solubility-Product.* **J. Stieglitz.** (Amer. Chem. Soc., Journ. 30. pp. 946–954, June, 1908.)—The idea of a constant "solubility product" for the ions of a sparingly soluble salt was deprived of its theoretical basis by the observation that the mass-action laws do not apply in their ordinary form to electrolytes. The author has examined a number of cases, and finds that in spite of its theoretical weakness the law affords a very reasonable expression of the experimental data. T. M. L.

1541. *Liquid Crystals and Mechanical Technology.* **O. Lehmann.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 387–392, March 7, 1908. Paper read before the Karlsruher Bezirksverein, Oct. 28, 1907.)—A discussion of the mechanical properties of liquid crystals, with a few references to cases in which they may be formed in technical work. T. M. L.

1542. *Diagrammatic Representation of Equilibria between Acids and Bases in Solution.* **L. J. Henderson.** (Amer. Chem. Soc., Journ. 30. pp. 954–960, June, 1908.)—Diagrams are shown which express the equilibrium between a strong base and acids of various strengths, and, on the other hand, between a strong acid and bases of various strengths. The diagrams are not suitable for strongly acid or alkaline solutions in which both acid and base are of considerable strength. T. M. L.

1543. *The Equilibrium*: $2Au_{(met)} + Au^{\cdot\cdot\cdot} \rightleftarrows 3Au^{\cdot}$ **E. Bose.** (Zeitschr. Elektrochem. 14. pp. 85–86, Feb. 21, 1908. Physikal.-chem. Laborat. d. techn Hochschule, Danzig-Langfuhr, Jan., 1908.)—The author shows that the equilibrium $2Au_{(met)} + Au^{\cdot\cdot\cdot} \rightleftarrows 3Au^{\cdot}$ exists, using the apparatus previously described [see Abstract No. 1769 (1907)]. It has previously been pointed out by Wohlwill [see Abstract No. 684 (1898)] that gold is soluble to some extent in a solution of auric chloride, giving a mixture of aurous and auric salts. Indications have been obtained that Pt behaves similarly to Au. T. S. P

1544. *Solubility of Nitric Oxide in Aqueous Solutions of Ferrous Sulphate, Nickel Sulphate, Cobalt Sulphate, and Manganese Chloride.* **F. L. Usher.** (Zeitschr Phys. Chem. 62. 5. pp. 622–625, April 28, 1908.)—The measurements were made with the ordinary Ostwald apparatus. The solubility of the (NO) is greater in ferrous sulphate solution than in water. In the other cases the solubility is less; these other salts merely "salt out" the gas as any other indifferent salts would do. D. H. J.

1545. *Transport of Liquids by the Electric Current.* **E. van der Ven.** (Archiv. Musée Teyler, 11. pp. 185–218, 1908.)—This paper contains a number of new results supporting the conclusions previously drawn. [See Abstracts No. 650, 1515 (1906).] T. H. P.

1546. *Electrolysis of Salt Solutions in Liquefied* SO_2 *at Low Temperatures.* **B. D. Steele.** (Faraday Soc., Trans. 3. pp. 164–165, Oct., 1907. Chem. News, 96. pp. 224–225, Nov. 8, 1907.)—Preliminary results are published in view of Magri's work on similar lines [Abstract No. 1729 (1907)].

1547. *Nernst's Theory on the Potential Difference between Electrode and Electrolyte.* **H. Pellat.** (Journ. de Physique, 7. pp. 195–203, March, 1908.)—The author shows that Nernst's theory concerning the p.d. between electrode and electrolyte leads to conclusions in disaccord with experimental results, and that a metal immersed in a solution of one of its salts is sensibly at the same potential as the solution, provided the latter is not too dilute. T. H. P.

1548. *Influence of Slow Dissociation upon Equilibrium of Phases.* **C. van Rossem.** (Zeitschr. Phys. Chem. 62. 3. pp. 257–283, March 31, 1908.)—The work of Ramsay and Young upon vapourisation and dissociation is reviewed and criticised. The "dissociation studies" of Bancroft [see Abstract No. 1222 (1899)] is used as a basis for explanation of the anomalies observed by Ramsay and Young. F. J. B.

1549. *Pulsating Catalysis of Hydrogen Peroxide by Mercury.* **A. v. Antropoff.** (Zeitschr. Phys. Chem. 62. 5. pp. 513–588, April 28, 1908.)—The periodic catalysis of hydrogen peroxide by mercury, discovered by Weinmayr and Bredig, was carefully followed experimentally. By means of a special apparatus the progress of the reaction was automatically registered, the apparatus registering the oxygen evolution and the changes in potential between mercury and solution simultaneously. The effect of various reagents upon the course of the reaction was also observed. For details the original article must be consulted. F. J. B.

1550. *Contact Potential-differences between Metals and Liquids.* **L. Bloch.** (Comptes Rendus, 146. pp. 1017–1018, May 18, 1908.)—Investigates the variation in the p.d. between a metal and distilled water as change is made from water to more concentrated aqueous solutions. L. H. W.

1551. *Electrochemical Equivalent and Temperature.* **F. Kohlrausch** and **R. H. Weber.** (Ann. d. Physik, 26. 3. pp. 409–488, July 7, 1908.)—The full paper corresponding to Abstract No. 517 (1908).